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NUCLEAR SCIENCE ABSTRACTS

OCT 19 1964

Volume 18 Number 18

Abstracts 31060–33210

INCLUDES ABSTRACTS OF USA GENEVA 1964 PAPERS

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A title page for Volume 18, Numbers 13–18 is included at the back of this issue for use in binding the third quarter of the volume.

CORRECTIONS

NSA Vol. 18, No. 4, p. 848. In abstract 6300, report number CEA-4735 should be GA-4735.

NSA Vol. 18, No. 7, p. 1532. In abstract 11548, in descriptive cataloging, Vol. 4 should be Vol. 3.

NSA Vol. 18, No. 8, p. 1631. In abstract 12166, journal reference Chem. Soc. (Taiwan) should be J. Chinese Chem. Soc. (Taiwan).

NSA Vol. 18, No. 9, p. 1894. In abstract 14035 report number TID-20227 should be TID-20377.

NSA Vol. 18, No. 9, p. 1929. In abstract 14332 report number NYO-10463 should be GIC-2605-1.

NSA Vol. 18, No. 10, p. 2310. In abstracts 17303 and 17304, (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay) should be (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium).

NSA Vol. 18, No. 10, p. 2320. In abstract 17371 report number SC-T-64-65 should be SC-T-64-45.

Volume 18, Number 18, September 30, 1964

NUCLEAR SCIENCE ABSTRACTS

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ACKNOWLEDGMENTS

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

Volume 18, Number 18 September 30, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 31832.

31060 (NP-13975) LOCALIZACIÓN DE LA PLACENTA POR MEDIO DE LOS ISÓTOPOS RADIOACTIVOS. INFORME NO. 97. (Localization of the Placenta Using Radioactive Isotopes. Report No. 97). Leon Fisch, Hernan Garcia del Rio, and Victorio Pecorini (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 12p.

Experiences on the localization of the placenta using radioactive iodated albumin circulating through the placenta were reported for 20 cases. The Weinberg modification of the Browne and Veall method was used to detect the radioiodine. The results from the radioactive tracers were verified by placentography in 2 cases, by intrauterine feel in 18 cases, and by caesarian operation in 2 cases. The efficiency of the method was indisputable with respect to high or low insertion of the placenta. The simplicity of the injection and safety for fetus and mother suggest its routine use. (J.S.R.)

31061 (NP-14125) ANNUAL PROGRESS REPORT [ON BIOLOGICAL HAZARDS OF FALLOUT], JULY 1, 1963–JUNE 30, 1964. William E. Rothe, Edward J. Huycke, Jon W. Blumenstock, and Erich Oberhausen (Army Medical Research Unit No. 1, Landstuhl Army Medical Center, Germany). 18p.

Whole-body measurements made between July 1963 and July 1964 on 300 individuals over 22 years of age residing in the Federal Republic of Germany revealed increasing levels of ^{137}Cs during the latter half of 1963. Results are reported from follow-up tests of patients with carcinoma of the thyroid gland in whom ^{131}I retention was measured by whole-body counting; measurements of lean body mass based on whole-body ^{40}K measurements; whole-body ^{131}I-Triolean absorption studies in patients with gastrointestinal complaints; whole-body measurements of potassium exchange after injection of ^{42}K to patients with hepatic cirrhosis; whole-body measurements of the absorption of orally administered ^{59}Fe in normal persons and patients with maladsorptive syndromes; and whole-body measurements of Ra and Th burdens in persons with deposits of these radionuclides. Whole-body measurements of γ activity were also made in 36 industrial workers. An α counter was developed and built for the assay of biological samples. The properties of adenine for the enhancement of preservation of stored whole blood were investigated. (C.H.)

31062 (OTS-63-11409/6) POLISH MEDICAL JOURNAL. Translation of Polish Med. J., 2: No. 6, 1963. 224p.

A separate abstract was prepared for one paper in this journal. Other papers cover various subjects of general medical interest. (C.H.)

For an abstract of the individual paper see: 31318.

31063 (OTS-63-11456/1) ACTA MEDICA IUGOSLAVICA. Translation of Acta Med. Iugoslav., 17: No. 1, 1963. 88p.

A separate abstract was prepared for one paper. Other papers cover diverse subjects of general medical interest. (C.H.)

For an abstract of the individual paper see: 31134.

31064 (TID-3078(Suppl.1)) RADIOISOTOPES IN AGRICULTURE: ANALYTICAL PROCEDURES, ANIMAL HUSBANDRY, ENTOMOLOGY, FERTILIZER UPTAKE, GENERAL STUDIES, PHOTOSYNTHESIS, PLANT GENETICS, AND PLANT PHYSIOLOGY. A Selected Bibliography. Helen L. Ward, comp. (Division of Technical Information Extension, AEC). May 1964. 24p.

A total of 229 selected references are presented from literature published from 1958 to 1962 on uses of radioisotopes in agricultural sciences. (C.H.)

31065 THE USE OF DESCRIPTIVE GEOMETRY FOR THE LOCALIZATION OF SOURCES OF RADIUM, RADON AND ARTIFICIAL RADIOISOTOPES FOR DOSIMETRIC PURPOSES. J.-M. Légaré (Henry Ford Hospital, Detroit). Acta Radiol., 1: 288-302(1963).

A graphical method of localizing radioactive sources is illustrated by means of a cylindrical implantation of linear sources, a single plane implantation of radioactive grains, and an intracavitary application of Ra. Excerpta Med., Sect. XXIII, 1: No. 4.

31066 CEREBRAL BLOOD FLOW ASSESSMENT WITH A RADIOISOTOPE METHOD. Stephen W. Thompson (Univ. of Oklahoma, Oklahoma City and Veterans Administration Hospital, Oklahoma City). Arch. Neurol., 10: 26-34(Jan. 1964).

A radioisotope tracer method for measuring cerebral blood flow is presented. It is innocuous and relatively simple and is capable of measuring the flow, which is expressed in arbitrary units as Flow Index, through a region restricted to the range of a γ-ray detector placed against the head. Measurements were made on a series of adult subjects. In 51 normal subjects between 19 and 70 yr old

the mean flow index for the left side of the head was 15.7 ± 3.1, and that for the right side of the head 16.8 ± 3.5. Individual side-to-side differences were between 0.1 and 3.3. No significant difference between the flow indices from the normal subjects who were over 50 yr old and those from the normal subjects under 50 yr of age was found. Possible reasons for this are discussed. Inhalation of 5% carbon dioxide for five minutes produced the expected increase in the flow indices in five normal subjects. Results are presented for 32 patients with evidence of arteriosclerosis of a common carotid artery or its major branches. (C.H.)

31067 X-RAYS AND AFTER. R. Bonnett (London Univ.). Chem. Ind. (London), No. 19: 794-6(May 9, 1964).

The use of x-ray diffraction techniques for the study of the structure of low molecular wt organic compounds is briefly reviewed, with emphasis on investigation of vitamin B_{12}. (BBB)

31068 STUDIES ON PHOTOREACTIVATION OF E. COLI/G AND ITS DNA FOLLOWING ULTRA-VIOLET IRRADIATION. K. Dhar and A. Guha (College of Medical Sciences, Banaras, India and Hindu Univ., Varanasi, India). Intern. J. Radiation Biol., 7: 421-6(Nov. 1963).

The nature of photoreactivation of uv-irradiated E. coli G was compared with that of the DNA in vitro extracted from the same microorganism. When the cells, after irradiation, were exposed to light, the survival fraction remained constant for 5 min. Then there was an exponential increase up to 30 min. After 30 min the survival fraction decreased exponentially. The irradiated specimens kept in the dark showed an exponential increase in the survival fraction throughout. The highly polymerized DNA samples showed a similar behavior in in vitro experiments. (auth)

31069 INFLUENCE OF MONOCHROMATIC ULTRAVIOLET LIGHT ON THE TRANSFORMATION ACTIVITY OF BACILLUS SUBTILIS. A. Haug and E. Goes (Universität, Cologne). Intern. J. Radiation Biol., 7: 447-52(Nov. 1963).

Dose and wavelength dependence of the inactivation of transforming-DNA by uv radiation were investigated. The extent of damage was measured on the transforming system of Bacillus subtilis, in which an indole-requiring strain was transformed to prototrophy by wild-type DNA. The quantum yield was found to be independent of wavelength in the range $240 \leq \lambda < 300$ mμ. Of the total number of inactivating lesions produced at the indole marker by 285 mμ radiation, none could be reversed by subsequent irradiation at 240 mμ. It was concluded that cytosine is involved in the biological damage. The differences of the indole marker of Bacillus subtilis towards the inactivation of the streptomycin marker of Haemophilus influenzae are discussed. (auth)

31070 LAMB CARCASS AND LIVE LAMB EVALUATIONS BY POTASSIUM-40 AND CARCASS MEASUREMENTS. M. D. Judge, M. Stob, W. V. Kessler, and J. E. Christian (Purdue Univ., Lafayette, Ind.). J. Animal Sci., 22: 418-21(May 1963).

Evaluations of lamb carcasses by weights, measurements, and potassium-40 analyses permitted the comparison of the methods on the basis of edible portion, excess fat, and bone constituents. Potassium-40 measurements were shown to be significantly related to the edible portion, excess fat, and bone composition of the carcasses. Measurements of longissimus dorsi area and external fat thickness were also significantly related to edible portion and excess fat proportions. In live lambs, the correlations between potassium-40 activity and percent edible portion were significant in one of four cases. Potassium-40 correlations with percent excess fat ranged from 0.72 to 0.89. Longissimus dorsi area and fat thickness carcass measurements were significantly related to edible portion and excess fat percentages of live weight. (auth)

31071 AMINO ACID ACCUMULATION IN ETHIONINE-RESISTANT SACCHAROMYCES CEREVISIAE. W. A. Sorsoli, K. D. Spence, and L. W. Parks (Oregon State Univ., Corvallis). J. Bacteriol., 88: 20-4(July 1964).

Recessive ethionine-resistant strains of Saccharomyces cerevisiae possess a genetic lesion affecting the concentration of amino acids nonspecifically in the expandable pool of the organism. This area, which may be linked to a methionine gene, is highly mutable and accounts for resistance to certain amino acid analogues. Other mutations result in ethionine resistance by a mechanism unrelated to the amino acid uptake system. (auth)

31072 NUTRITIONAL MUTATIONS AND TRANSDUCTION BY ULTRAVIOLET-INACTIVATED PHAGE IN STAPHYLOCOCCUS AUREUS. A. Carere and Isabella Spada-Sermonti (Istituto Superiore di Sanità, Rome). J. Bacteriol., 88: 226-32(July 1964).

By use of a semisynthetic medium, various nutritional mutants of Staphylococcus aureus 80 were isolated. Most of them require purine derivatives. From their mutation pattern, it may be inferred that guanine can be converted to both guanilic and adenilic acid, and adenine to the latter only. Guanosine, hypoxanthine, and inosine appear to be intermediate in the synthesis of adenilic acid from exogenous guanine. Transduction of several nutritional markers was obtained by streaking phage 80 obtained from the donor strain onto selective media heavily seeded with the recipient strain. To prevent lysis, the phage was previously uv-inactivated. (auth)

31073 X-RAY DOSE MEASUREMENTS WITH A LOCALLY CONSTRUCTED WATER PHANTOM. G. R. Ridings and R. E. Johnston (Univ. of Missouri, Columbia). J. Oklahoma State Med. Assoc., 56: 334-7(July 1963).

A brief description is presented of a simple, relatively inexpensive device for the accurate measurement of radiation dose distributions for specific treatment fields; it can be constructed on a very limited budget, yet can enable increased control and accuracy in radiation dosimetry and increased versatility in treatment planning. When measurements of the central axis depth doses were made using this system and the results compared to other reported measurements, there was almost exact correlation. The isodose distributions were determined for specialized treatment fields. One such fields is shown in which a wedge filter of Pb was used to produce isodose curves at a 45° angle. (BBB)

31074 THE CONCEPT OF ABSORBED ENERGY AND THE MODERN DOSIMETRIC DEFINITIONS. Franco Bistolfi. J. Radiol., Electrol. Med. Nucl., 45: 133-48 (Mar.-Apr. 1964). (In French)

The fundamental definitions of force, weight, mass, work, energy, power, and the units for their measurement in the C.G.S. system are reviewed. The erg unit and its relations with the ev and Mev units together with the mechanical equivalent of the calory are emphasized. A comparison is made between the absorbed dose unit, the rad, and the three fundamental energy units, the erg, ev, and small calory. The general calculation of the energy absorbed by air and tissues after exposure to a given dose of x and gamma rays is shown. Examples are given for the calculation of the absorbed dose in rads, under various experimental conditions.

The close relation between LET, linear ionic density, RBE, and rem is discussed. It is affirmed that all these definitions lead to the same fundamental problem, i.e., the problem of the energy absorbed by the biological medium exposed to a beam of ionizing radiation. (auth)

31075 PROGRAMMING A RADIONUCLIDE ANIMAL TREATMENT FACILITY. A. C. Andersen (Univ. of California, Davis). Lab. Animal Care, 13: No. 3, Pt. 2, 299-317(June 1963).

Pertinent factors in the design of radionuclide labs are considered. Cooperation between researcher and designer is stressed. To illustrate these features, the cage design and biological waste treatment facility found acceptable for treating beagles on high doses of ^{90}Sr and ^{226}Ra is presented. A decontamination facility for ^{90}Sr-containing excreta was designed. (OTS)

31076 INCORPORATION OF TRITIUM INTO HUMAN PLASMA TRIGLYCERIDES FROM GLUCOSE-1-^{3}H AND LACTIC ACID-2-^{3}H. A. Ghose, W. W. Shreeve, Y. Shigeta, and I. L. Schwartz (Brookhaven National Lab., Upton, N. Y. and Univ. of Cincinnati). Nature, 201: 722-3(Feb. 15, 1964). (BNL-7554)

The incorporation of tritium into human triglycerides and body water was studied in lean diabetic, obese mild diabetic, and obese non-diabetic patients. Glucose-1-^{3}H or DL-lactate-2-^{3}H was administered to fasted patients, blood samples were drawn at various time intervals, and measurements were made of the concentration of plasma triglyceride, and the content of tritium in purified plasma triglyceride and in plasma water. Separate measurements with injected tritiated water were used to determine the total body-water in each patient. Data are presented on the triglyceride level and its specific tritium activity as well as the per cent dose of tritium in total body water for each patient. Higher activity relative to the tritium dose was found in the triglyceride of patients given lactate-2-^{3}H than in those given glucose-1-^{3}H, however lactic acid in the blood was shown to be metabolized somewhat faster than glucose. Results are discussed in terms of metabolic differences in lean, obese, and diabetic patients. (C.H.)

31077 IMMUNIZATION AGAINST THE CATTLE LUNGWORM: EXPERIMENTS ON ORAL VACCINATION OF CALVES WITH X-IRRADIATED DICTYOCAULUS VIVIPARUS LARVAE. John T. Lucker and H. H. Vegors (Agricultural Research Service, Beltsville, Md.). Proc. Helminthol. Soc. Wash., D. C., 31: 92-104(Jan. 1964).

Two experiments are reported on the efficacy of oral vaccination of calves with x-irradiated larvae for protection against patent infection with Dictyocaulus viviparus. One experiment was patterned after the earlier one of Jarrett et al. in which vaccination with 4000 irradiated larvae was found to induce a high level of protection. However, both the level of the challenge exposure here and the interval from vaccination to challenge were intentionally greater than in the earlier test. The second experiment was intended to ascertain whether the rate of x irradiation might be an important determinant of the induced level of resistance. The larvae were irradiated in water with a dose of 40,000 r delivered at its surface, and, in the first experiment, calves were vaccinated once with 4000 of the larvae irradiated at a rate of about 2650 r/min. At about four months postvaccination the calves were not resistant to a challenge dose of about 15,000 normal larvae, and the average number of worms recovered from them about one month postchallenge was about equal to the average number recovered from two control calves. In the second experiment, pairs of calves were doubly vaccinated with larvae irradiated rapidly and at three much slower dose rates. The interval between vaccinations with ~1000 larvae was seven weeks and the interval from second vaccination to challenge with 10,000 larvae was ~ two months. The irradiation rates tested were 100, 200, 400 r/min, and the combination of 2900 r/min for initial, and 1200 r/min for second, vaccination. The average numbers of worms recovered about one month postchallenge from the pairs vaccinated with larvae irradiated at these rates were 50, 1322, 320, and 97, respectively. The average number recovered from four control calves was 1900. Thus, the rate of irradiation is rejected as the prime determinant of efficacy of the vaccinations because the postchallenge worm loads did not vary directly or inversely with the rate. Variation in capacity to develop resistance is deemed largely responsible for the observed differences in efficacy of the vaccinations. (BBB)

31078 BODY COMPOSITION RELATIVE TO MOTOR APTITUDE FOR PREADOLESCENT BOYS. A. H. Ismail, J. E. Christian, and W. C. Kessler (Purdue Ave., Lafayette, Ind.). Res. Quart., 34: 462-70(Dec. 1963).

The data for 40 variables were obtained from 81 Purdue University faculty sons between 10 and 12 years of age inclusive. Among the 40 variables, 680 correlation coefficients were obtained. Factor analysis was used to identify the factors which could explain the items measuring body composition and motor aptitude. As a result, eight factors were isolated and given names. The factors underlying the 40 variables seemed to permit the following names: growth and maturity factor, body fitness factor, body balance on object factor, coordination of the lower extremities factor, general kinesthetic sense factor, general static balance factor, directionality factor, and laterality factor. Observing the factor loadings in Factor I, it may be concluded that the measurement of lean body weight by liquid scintillation counting technique is significant in the assessment of growth and maturity in preadolescent boys. Furthermore, in the assessment of body fitness pertaining to preadolescent boys, it is revealed that the percent lean body weight is the most important item as indicated by the value of factor loading presented in Factor II. (auth)

31079 A MICROMETHOD FOR THE TRITIUM MARKING OF STEROIDS AND ECDYSONE. P. Karlson (Universität, Munich), R. Maurer, and M. Wenzel. Z. Naturforsch., 18b: 219-24(1963). (EUR 510.d) (In German)

Ecdysone is the hormone that controls metamorphosis in insects. A modified Wilzbach technique was developed for labeling of the metamorphosis hormone with tritium. Polyhydroxysteroids (Δ^{1}-5α-Pregnendiol-(17α,21)-trion(3,11,20)-21-acetate and 5α-Pregnandiol-(17α,21)-trion(3,11,20)-21-acetate) were used as model substances. The best yields and highest activities were obtained by adsorbing the substances on granulated and activated charcoal, enclosing the absorbates in Nylon bags and exposing them to high doses of tritium at room temperature. The adsorption resulted also in a decrease of radioactive by-products. The tritiated substances were purified by thin-layer chromatography, using a special flow-counter for activity measurements on the chromatoplates. The method described is especially valuable with small amounts (5 to 20 mg). Specific activities up to 250 μC/mg of the pure substances were obtained. (auth)

31080 RADIOACTIVITY. Recommendations of the International Commission on Radiological Units and Mea-

surements (1962) (ICRU). Report 10c. National Bureau of Standards Handbook 86. (National Bureau of Standards, Washington, D. C.). 1963. 53p. $0.40(GPO)

Developments since 1959 are reviewed in the field of absolute standardization of radiological units and measurements. Emphasis was placed on methods for the evaluation of the exposure of man to ionizing radiations arising from medical procedures. Topics discussed in detail include direct and relative measurements of the activity of radioactive sources, low-level radioactivity in materials and its relation to radiological measurements, the availability of radioactivity standards, and techniques for measuring radioactivity in biological samples and living subjects. (C.H.)

31081 BIOLOGICAL EFFECTS OF DEUTERIUM. J. F. Thomson. A Pergamon Press Book. International Series of Monographs on Pure and Applied Biology. Division: Modern Trends in Physiological Sciences. Volume 19. New York, The Macmillan Company, 1963.

Alterations produced in biological systems by substitution of deuterium for hydrogen are discussed. The preparation and physical properties of deuterium, and techniques used for the quantitative analysis of D_2O-H_2O mixtures are reviewed. The effects of deuterium on isolated enzymes, viruses, one-celled forms of life, and more complex organisms up through mammals are described. Effects of deuterium on radiosensitivity of organisms are discussed. It is pointed out that, although a wealth of experimental data has been accumulated, some basic questions remain unanswered. These questions deal with the diversity of the responses of various species to deuterium, mechanisms of the toxic action of deuterium, and mechanisms of adaptation or acclimatization to deuterium. (285 references.) (C.H.)

Ecology

31082 (EUR-1612.f) ÉTUDE DES NIVEAUX DE CONTAMINATION RADIOACTIVE DU MILIEU AMBIANT ET DE LA CHAINE ALIMENTAIRE. (Study of Radioactive Contamination Levels of the Environment and the Food Chain). France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). 1964. Contract 003-63-10PSAF. 20p.

In association with the CEA, the Euratom Commission has initiated a program of studies and research with the aim of establishing levels of radioactive contamination of food. Standards in respect to radioactive contamination of the food chain will be established. Results are summarized from studies and analyses already carried out including the collection and evaluation of currently existing scientific, technical, and statistical data in the fields of physiology, toxicology, agronomy, and the food industry, the basic biological data, and qualitative quantitative data relating to food consumption, and the transfer of radionuclides from sources of pollution to man. (C.H.)

31083 (HASL-147) HASL CONTRIBUTIONS TO THE STUDY OF FALLOUT IN FOOD CHAINS. Joseph Rivera and John H. Harley (New York Operations Office. Health and Safety Lab., AEC). July 1, 1964. 61p.

Data collected from 1954 to 1964 on the radioactive contamination of foods and total diet are compiled. The majority of the samples were analyzed for ^{90}Sr only, but some data are included on other fission products, certain natural radionuclides, and stable elements. Mechanisms of transfer of fallout fission products in the food chain to man and methods for predicting fallout body burdens from fallout deposition rates are discussed. (C.H.)

Metabolism, Tissue Distribution, and Toxicology

31084 (UR-648) THE FATE OF RADON INGESTED BY MAN. John B. Hursh, Donald A. Morken, Thomas Davis, and Arvin Lovaas (Rochester, N. Y. Univ. Atomic Energy Project). June 11, 1964. Contract W-7401-eng-49. 41p.

Results are reported from four experiments in which two subjects on two occasions drank approximately 1 μC Rn plus daughters in 100 ml of water. Measurements on Rn loss in expired air, whole-body Radium C content, and Rn in the blood were used in the calculation of an $(MPC)_w$ of 2.0×10^{-4} μC/ml for occupational exposure. This is based on the stomach as the critical organ, but doses to the lung, kidney, and liver were also estimated. (C.H.)

31085 EXPERIMENTAL POISONING WITH p-PHENYLENEDIAMINE OF RATS. NOTE III: ACUTE POISONING OF NORMAL AND HYPOPHYSECTOMIZED RATS. G. Ferlin, E. Tajoli, and F. Callegari (Università, Padua). Acta Isotopica, 3: 167-80(1963). (In Italian)

The thyroidal biological half life of ^{131}I was determined in normal and hypophysectomized rats that were acutely poisoned with p-phenylenediamine. A significant prolongation was observed in both groups of poisoned rats in comparison to normal controls. Histological examination confirmed the changes observed but failed to show any change in the pituitary gland of non-hypophysectomized poisoned rats. It was concluded that p-phenylenediamine acts directly on the thyroid gland without pituitary mediation. (C.H.)

31086 EFFECT OF BREATHING HIGH PRESSURE OXYGEN UPON TISSUE OXYGEN TENSION IN RAT AND MOUSE TUMOURS. D. B. Cater, E. L. Schoeniger, and D. A. Watkinson (Cambridge Univ., Eng.). Acta Radiol., 1: 233-52(1963).

Oxygen tension in rat and mouse tumors was measured by the oxygen-cathode technique and converted to radiosensitivity by the formula of Gray. Of 77 recordings made while the animals breathed O at 5 atm absolute, in a specially constructed pressure chamber, 45 reached near maximum radiosensitivity, and 9 showed a fall of O tension. Reasons for this are discussed. Factors altering tumor blood flow are also important in radiotherapy. After 5-HT, tumor O tension failed to rise during O inhalation even at 5 atm absolute. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31087 DISTRIBUTION OF RADIOTERBIUM, RADIOHOLMIUM AND RADIOYTTERBIUM IN MICE. AN AUTORADIOGRAPHIC STUDY. B. Ewaldsson and G. Magnusson (Royal Veterinary Coll., Stockholm). Acta Radiol. (N.S.), 2: 121-8(Apr. 1964).

The distribution patterns of ^{160}Tb, ^{166}Ho, and ^{169}Yb were studied by whole-body autoradiography. These lanthanides were accumulated mainly in the liver, skeleton, spleen, and kidney; ^{160}Tb was also accumulated by the adrenal cortex and cartilage, and ^{166}Ho by the adrenal cortex. The distribution patterns are compared with those of the lanthanides, ^{144}Ce and ^{147}Pm, previously studied by the same technique. (auth)

31088 RELATIONS BETWEEN ROOT ABSORPTION AND FOLIAR ABSORPTION OF STRONTIUM AND CESIUM IN THE CASE OF MAIZE. G. Barbier and M. Brossard (Station Centrale d'Agronomie, Versailles, France). Agrochimica, 7: 216-25(June 1963). (In Italian)

The relations between root absorption and foliar absorption of ^{89}Sr and ^{137}Cs were studied in young maize plants

treated with nutrient solutions containing Ca. The competition between K and Cs in both leaves and roots was also studied. Results showed that Cs deposited on the leaves migrates rapidly to the roots, where the presence of K influences accumulation. Strontium was absorbed in the roots in smaller amounts than Cs, but rose rapidly to the leaves. Strontium absorbed by leaves migrated to the roots very slowly. Strontium stored in the leaves impeded the rise of Sr from the medium to the leaves. (C.H.)

31089 HORMONAL EFFECTS ON DISTRIBUTION AND EXCRETION OF IODIDE-I^{131} IN THE DOG. Y. Takeda (McGill Univ., Montreal and Montreal General Hospital). Am. J. Physiol., 206: 1237-43(June 1964).

Studies of the kinetics of iodide-^{131}I given intravenously to control dogs and dogs receiving growth hormone, cortisone, and thyroxine showed that growth hormone and cortisone increased, whereas thyroxine decreased, the rate of urinary excretion of ^{131}I. By applying the kinetic analysis described previously it was found that the rates of distribution and excretion of iodide-^{131}I in the control and hormonal experiments were sufficiently rapid not to affect the interpretation of metabolic studies made with albumin-^{131}I in the dog. These results permit improved and more accurate estimates of the metabolism and distribution of plasma albumin in control dogs and dogs treated with the hormones. (auth)

31090 MARROW TRANSPLANTATION MEASURED BY UPTAKE OF Fe^{59} BY SPLEEN. L. H. Smith (Oak Ridge National Lab., Tenn.). Am. J. Physiol., 206: 1244-50(June 1964).

Transplantation of isologous (syngenic) bone marrow into lethally x-irradiated mice was quantified in terms of the degree to which the spleen incorporates ^{59}Fe. Spleen uptake of ^{59}Fe is linear with bone marrow cell dose and reflects the erythropoietic integrity of the transplanted cells. Parameters of the assay were investigated including x-ray exposure to the recipient, time of assay, ^{59}Fe uptake time and plasma clearance of the isotope. The following protocol was adopted: $(C_3H \times C_{57}BL)$ F_1 male mice are exposed to 850 r of x rays; injected with bone marrow 24 hr later; given ^{59}Fe 8 days later; and killed 6 hr after isotope injection to obtain spleens for ^{59}Fe analysis. The assay was used to determine radiosensitivity of the erythropoietic compartment of marrow and to determine integrity of marrow cells after short-term culture as a means of studying in vitro recovery from radiation damage. Results showed that the in vitro radiation exposure required to reduce the surviving cells to 37% (D_{37}) was 75 r. Studies of normal cells in short-term culture showed that cell integrity could be maintained for at least 6 hr in Tyrode's solution with calf serum at 22°C but that integrity was reduced after 6 hr at 37°C in all media tested. (auth)

31091 UREA TRANSPORT ACROSS DOG INTESTINAL MUCOSA IN VITRO. A. A. Hakim and Nathan Lifson (Univ. of Minnesota, Minneapolis and Ancker Hospital, St. Paul). Am. J. Physiol., 206: 1315-20(June 1964).

Mucosal membranes from the small intestine of the dog were stripped and mounted for study between two bathing fluids, as previously described. The relationship between urea and water transport, including uphill movement of urea in the direction of water flow, was that expected from a combination of bulk flow and diffusion. If sieving was present, it was minor. Results for downhill movement of D_2O, the isotopic water treated as a solute, were comparable to those for urea. (auth)

31092 AUTORADIOGRAPHIC AND HISTOLOGICAL INVESTIGATION OF CHANGES IN THE VISUAL SYSTEM OF RATS AFTER UNILATERAL ENUCLEATION. Joseph Altman and Gopal D. Das (Massachusetts Inst. of Tech., Cambridge). Anat. Record, 148: 535-46(Apr. 1964). (TID-20370)

Following surgical removal of one eye, rats were permitted to survive for three days, or one, two, and four months, and before killing, they were injected with 2 mc of leucine-^3H intraperitoneally. The utilization of this radiochemical was investigated in the brain autoradiographically. In all groups of animals the uptake of radioleucine, as determined by microdensitometry, was significantly higher in the degenerated optic nerve and tract than in their normal counterparts, with the relative difference increasing with longer postoperative survival within the periods tested. This progressive net increase in the utilization of leucine-^3H was associated with an absolute increase in the number of glia cells. Similar, but attenuated, density differences were also obtained with relatively large-aperture measurements over the stratum griseum of the superior colliculus in which the optic tract fibers terminate. In contrast, small-aperture measurements of grain density over single neurons in the lateral geniculate nucleus showed no difference in the utilization of leucine-^3H between the normal and subtotally deafferented sides. This suggests an absence of transneuronal changes in protein metabolism in the visual system of the rat as long as four months after unilateral enucleation. (auth)

31093 ACTION OF THREE CORTICOSTEROID HORMONES ON RUBIDIUM (^{86}Rb) EXCHANGE IN SURVIVING HEARTS OF HELIX ASPERSA (MUELLER). Jean-Charles Colin and Joseph Stolkowski (Université, Paris). Ann Endocrinol., 24: 538-51(July-Aug. 1963). (In French)

The action of three corticosteroid hormones (cortexone, cortisone, and cortisol) on ^{86}Rb movement in Helix aspersa hearts maintained in physiologic media was studied. After stabilizing 1½ hr in Cardot K solution, ^{86}Rb entry was studied by allowing a 2-hr preliminary period where K was replaced by ^{86}Rb, then a period of 4 hr was used to examine the effect of added hormone. Loss of ^{86}Rb was examined after allowing the hearts to stand 7 hr in ^{86}Rb solution. In the presence of glucose, cortisone and cortisol increase the amount of ^{86}Rb incorporated; but cortexone acetate has no effect. In the presence of variable K concentrations, cortexone exhibits the same action on ^{86}Rb entry. The rate of incorporation is illustrated. Loss of ^{86}Rb was examined as follows: without glucose, 4 hr, time 0, 24.9; controls, 16.5; cortisone, 14.4. Time 0, 31.1; controls, 13.5; cortexone, 15.2. With glucose, 5 hr, time 0, 25.2; controls, 17; cortisone, 17.6. Time 0, 29.5; controls, 16.1; cortexone, 16.6. Previous studies are cited to indicate that K and Rb movements are not similar, especially when cortisol is added to the mixture. Competition with H ions is also discussed. (BBB)

31094 INFLUENCE OF THE STRONTIUM–CALCIUM RATIO ON THE GROWTH AND ABSORPTION OF STRONTIUM AND CALCIUM IN PISUM SATIVUM L. C. Mytteneare (CEN, Mol, Belg.). Ann. Physiol. Vegetale l'Univ. Bruxelles, 8: 47-60(1963). (In French) (EUR-552.f)

A test was carried out to study the influence of the Sr/Ca ratio on the growth, absorption and concentration of calcium and strontium in Pisum sativum L. Activation analysis was used for determining the Sr contents of the different parts of the seeds used. Half the average quantity of Sr in a seed was concentrated in the spermoderm. Comparable results were obtained for calcium. (auth)

31095 THYROIDAL I^{131} UPTAKE PATTERNS FOLLOWING IODIDES. J. T. Taguchi, C. F. Powell, and N. F. Nickerson (Ohio State Univ., Dayton). Arch. Internal. Med., 112: 569-73(1963).

The ^{131}I uptake patterns of 23 euthyroid patients were studied at varying intervals following the termination of inorganic iodide administration. None of the patients developed clinical evidence of thyroid dysfunction during the period of the study. Eight of the 23 patients showed abnormalities in the 24-hr ^{131}I uptake. Three showed a rebound phenomenon, and five exhibited prolonged suppression. Of the three former patients, one had a rebound phenomenon persisting for at least 49 days. Of the five latter individuals, two had depressed radioiodine uptakes, persisting for five months and one year, respectively. Thyroid-stimulating hormone temporarily reversed the suppression in these two. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31096 THE PREPARATION OF LABELED ALBUMIN FOR TURNOVER STUDIES. Sheldon Margen and Harold Tarver (Univ. of California, Berkeley and Univ. of California Medical Center, San Francisco). Atomlight, No. 39, 12p.(July 1964).

Techniques used in labeling proteins are reviewed. It was concluded that no completely satisfactory technique has been established. In theory it would appear that the technique using tosylated amino acids or similar derivative or other simple compounds that cannot re-enter the metabolic pool has the most potential validity and usefulness. However, all techniques described must await further comparison between the Hevesy technique and the ^{131}I labeling technique. It is clear that if there is still deviation between the ^{131}I technique and the other techniques utilizing amino acids or their analogs which are not capable of re-entering the metabolic pool, that the iodine technique will have to be abandoned as a useful and valid technique for studies of turnover of plasma albumin. (auth)

31097 IODINE-131 LEVELS IN MILK IN AUSTRALIA DURING PERIOD MAY–NOVEMBER 1962. J. Bonnyman and D. W. Keam (Commonwealth X-Ray and Radium Lab., Melbourne). Australian J. Sci., 26: 74-6(Sept. 1963). (A/AC.82/G/L.866)

Resumption of nuclear weapons test in the Pacific Ocean at the end of April 1962 prompted institution of a program for checking iodine-131 levels found in milk from Australia. Representative samples of liquid milk from Perth, Adelaide, Melbourne, Sydney, Brisbane, Townsville, and Tasmania (a sampling representative of at least 90% of the milk consumed) were subjected to chemical analyses and radioassays. The highest of the ^{131}I levels for the seven sampling areas (expressed as pc/l of whole milk at the time of sampling) was a value of 68 pc/l for a Brisbane sample. None of the weekly samples gave a value exceeding 15 pc/l, and the average concentrations for all sampling stations for the period of weekly sampling was less than 5 pc/l. If values for ^{131}I concentration are weighted according to the population, the representative value for the whole of the Australian population is 2% of the level specified by the National Radiation Advisory Committee for Australia. The percentage of the specified integrated annual concentration calculated from published data is tabulated for various countries. (H.M.G.)

31098 ^{13}C KINETIC ISOTOPE EFFECTS IN THE UREASE-CATALYZED HYDROLYSIS OF UREA. II. INFLUENCES OF REACTION VARIABLES OTHER THAN TEMPERATURE. K. R. Lynn and Peter E. Yankwich (Univ. of Illinois, Urbana). Biochim. Biophys. Acta, 81: 533-47 (1964).

The effects of reaction variables other than temperature on the ^{13}C kinetic isotope effects in the urease-catalyzed hydrolysis of urea were measured with several preparations of enzyme (urea amidohydrolase, $EC_{3.5.1.5}$) in two buffers (maleic acid-maleate, and tris-sulfuric acid) in which the kinetics had been studied previously. Variables tested were: extent of reaction, age of enzyme preparation, pH and ionic strength of the medium, concentrations of urease and urea, and nature of buffer. The results support the conclusions, based on the earlier study of the temperature dependence of the isotope effects, that changes in reaction conditions which are without effect on the gross rate phenomena do, nonetheless, bring about changes in the kinetic isotope effects, and that complexity at the molecular level, probably involving temperature-dependent interconversion of two or more types of active sites (directly, or indirectly, through enzyme conformational changes), is responsible for the isotope effect results obtained. (auth)

31099 EFFECT OF THE SEASONS OF THE YEAR UPON THE UPTAKE OF I-131 BY THE THYROID GLAND IN THE FROG (RANA RIDIBUNDA PALL.). Alojz Caputa (Inst. of Endocrinology, Bratislava). Biologia, 19: 359-65 (1964).

The study involved time intervals of 1 to 168 hours; it showed a definite correlation between the seasons and the uptake of I-131; this was significantly higher in the spring and in the autumn. The difference was shown up to 96 hours; in the spring the maximum intake was at the 72nd hour; in the autumn the initial uptake was very slow, attained a uniform level at the 96th hour, and was still continuing after 168 hours. This applied both in absolute values and in values per unit of body weight; the spring time frogs had higher uptake per unit weight of the body at all time intervals than the autumn frogs. (auth)

31100 THE SELF-ABSORPTION CORRECTION OF CALCIUM-45 IN BIOLOGICAL MATERIAL. R. A. Hickie (Univ. of Toronto). Can. J. Physiol. Pharmacol., 42: 594-7(July 1964).

The self-absorption of ^{45}Ca was studied in dried, ground rat liver. Calcium-45 chloride in distilled water was mixed with the liver homogenate. Powdered samples 1 mg and 10 to 400 mg in weight were counted for a total of 6000 and 10,000 counts respectively. Self-absorption correction factors were calculated for each sample weight by the formula of Hendler. The relation between the self-absorption correction factors and the sample weights was found to be linear for ^{45}Ca present in the liver homogenate. Results are compared with those of Hendler and Katz. (H.M.G.)

31101 SYSTEMS AND MECHANISM OF IN VITRO DEIODINATION OF THYROID HORMONES. J. Nunez, G. Jacquemin, D. Brun, L. Rappaport, and J. Roche (College de France, Paris). Compt. Rend. Soc. Biol., 157: 1416-19(1963). (EUR 1680.f). (In French)

Tritiated analogs of thyroid hormones were prepared including $\alpha\beta$ 3,5, or 3',5'-^3H-thyronine, $\alpha\beta$ or 3,5-^3H-tyrosine, 3,5-^3H-thyroacetic, and p-hydroxyphenylacetic acids, o-, m- and p-$\alpha\beta$-^3H-3,5-diiodothyronines. These compounds and ^{125}I-^3H-thyroxine and 3,5,3'-triiodothyronine were used to study the systems and the mechanism of in vitro deiodination of thyroid hormones. Results showed that the system microsomes-Fe^{2+} deiodinates the iodothyronines together with other biological preparations. A protein complex containing the carbon rings of the hormone is formed. Quantitative differences appear however. With all protein con-

taining deiodinating systems mentioned, there is an identical proportion of radioiodine liberated in both the iodide and protein complex fractions. In the conditions described, several structural analogs having a phenol group lead to formation of a protein complex except those with the phenol in m-position: oxidation of this phenol to semi-quinone seems necessary for this reaction. A hypothesis is suggested for this mechanism. (auth)

31102 ON THE EXCRETION OF RADIOACTIVE STRONTIUM. Eiichi Ogawa (Gunma Univ., Japan). Genshiryoku Kogyo, 9: No. 11, 41-5(Nov. 1963). (In Japanese)

Male ddN strain mice weighing 20–25g were injected with ^{90}Sr or ^{85}Sr subcutaneously, and the effects of various drugs on their 3-day excretion and skeletal retention on the 4th day were studied. Of the chelating agents, NaCa citrate, NaMg citrate, NaSr citrate, Achromycin (or tetracycline), and aspartic Mg K (alone or in combination with NH_4Cl) showed Sr* excretion effect. ATP increased the excretion but did not reduce the retention in bone. EDTA, DTPA, BADE, tricarballylate, Na citrate, and NaPb citrate were not effective. Of the salts, Mg salt, sulfate, and thiosulfate were effective in excreting Sr*, the last salt showing a higher effect when administered with Mg, Ca, or Sr salt. Ca and Sr salt showed no effect, and ammonium chloride promoted only urinary excretion but not fecal or total excretions. Such salts as induce alcalosis showed inhibitory effect. Of the hormones, glucocorticoids had Sr* excretion effect. TSH was effective, and antithyroidal drugs were the reverse. Of the vitamins, cocarboxylase increased the excretion but did not reduce the retention in bone. Metabolic inhibitors were ineffective, and NaF increased the bone deposition of Sr*. (auth)

31103 THE BEHAVIOR OF THORIUM DIOXIDE IN THE ORGANISM OF RATS ON INTRATRACHEAL ADMINISTRATION. Hsiao-shan Yen. Gigiyena Truda i Prof. Zabolevaniya, No. 10, 46-51(1962).

Thorium dioxide, administered intratracheally, was detected during the first 5 days in the lungs, trachea, lymphatic nodes of radices pulmonis and of the neck, in the gastrointestinal tract (in the contents), liver, spleen, bones, kidneys, urine, and feces; after 5 months, only in the lungs, bones, and lymphatic nodes of radices pulmonis and of the neck. During the first 10 days the lungs contained 50–73% of the administered amount; after 21 months–30%. In some animals the late sequels were observed to include development of cancer and sarcoma of the lungs. (OTS)

31104 COMPARATIVE UTILIZATION OF DIETARY CALCIUM AND STRONTIUM-90 BY PIGS AND SHEEP. D. E. Hogue, W. G. Pond, C. L. Comar, L. T. Alexander, and E. P. Hardy (Cornell Univ., Ithaca, N. Y. and New York Operations Office, AEC). J. Animal Sci., 20: 514-17 (Aug. 1961).

The comparative utilization of dietary calcium and of ^{90}Sr was determined in pigs and sheep under typical management conditions by balance feeding trials, radioassay for ^{90}Sr present in feedstuffs in 1958, and chemical analysis for calcium. A ration consisting of hay from crop year 1958, soybean meal and corn ranged from 74 to 93 $\mu\mu C$ ^{90}Sr/gm Ca. The hay contributed about 90% of the ^{90}Sr intake of the animals. The pigs started with a body burden of 3.7 $\mu\mu C$ ^{90}Sr/gm Ca and finished with 9.4; comparative values for the sheep were 30 and 27. For the pigs the comparative utilization and calcium and ^{90}Sr and 48 and 8.6% respectively; values for the sheep were 30 and 6.3%. In agreement with values for other species, the pigs and sheep utilized ^{90}Sr about 0.2 as effectively as calcium. (auth)

31105 RADIOIODINE METABOLISM IN THE GOAT AFTER SIMULTANEOUS SINGLE AND DAILY ADMINISTRATION. W. T. Binnerts, F. W. Lengemann, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). J. Dairy Sci., 45: 427-9(Mar. 1962).

Simultaneous administration to goats of two radionuclides of iodine, ^{125}I and ^{131}I, revealed no significant difference between the sum total of excretions in milk, urine, and feces after a single dose, compared with the average of the steady state excretions after daily ingestion. The experiments indicated that information from single doses of radioiodine can be extrapolated to predict the behavior of iodine under conditions of daily ingestion. Iodine-125 was found to be of advantage in large animal experiments because of its long half-life, 57 days, and was found not to interfere with the determination of ^{131}I when using a single channel analyzer. In turn, ^{125}I could be separated from ^{131}I by allowing ^{131}I to reduce to low levels by physical decay. (auth)

31106 THE UTILIZATION OF EGG IODINE BY THE CHICKEN EMBRYO. J. Okonski, F. W. Lengemann, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). J. Exptl. Zool., 145: 263-9(Dec. 1960).

The uptake of endogenous egg iodine by the chicken embryo was studied by incubating fertile eggs labeled by feeding daily doses of I-131 to laying hends over a 30-day period. Samples of muscle, thyroid, blood, and allantoic fluid collected from the embryos of the labeled eggs showed that I-131 was present in all tissues of the 6-day-old embryo, the youngest embryo collected. The thyroid concentrated I-131 by a factor of 500 times that of muscle. The I-131 concentration in the tissues of the embryo declined between the 7th and 9th days of incubation and then rose again. Single injections of I-131 into the allantoic veins of embryos of 8 to 19 days of age showed that the rate of uptake of radioiodine declined with increasing age. The yolk was shown to sequester the major amount of I-131 from the injection into the blood. Injection of I-131 into the albumin indicated that the availability of iodine from this store is highest in the early stages of embryonic development. Injection of I-131 into the yolk showed a relatively low availability to around 9 days and than a rapid increase. The temporary decrease in the tissue I-131 concentration of 7- to 9-day-old embryos is discussed from the standpoint of the failure of the albumin and yolk to provide relatively uniform levels of available iodine for the developing embryo. (auth)

31107 EFFECTS OF D_2O AND OSMOTIC GRADIENTS ON POTENTIAL AND RESISTANCE OF THE ISOLATED FROG SKIN. Barry D. Lindley, T. Hoshiko, and D. E. Leb (Western Reserve Univ., Cleveland). J. Gen. Physiol., 47: 773-93(Mar. 1964).

Exposure of the outside surface of isolated frog skin (Rana pipiens and Rana catesbeiana) to sulfate solution made up with D_2O decreased skin potential and resistance. Exposure of the inside surface to D_2O solution decreased the potential slightly but increased the resistance. The changes were linearly related to the D_2O concentration. Since D_2O acts like a hyperosmotic solution, the skin potential and resistance were studied upon exposure to solution made hyperosmotic by addition of sucrose, mannitol, acetamide, urea, thiourea, Na_2SO_4, or K_2SO_4. Skin potential and resistance decreased when the outside solution was made hyperosmotic. The changes depended upon the concentration and the nature of the solute. Thiourea and urea solutions were the most effective. Treatment of the inside surface gave relatively small decreases in

potential; the resistance either increased or remained unchanged. These effects appeared to depend upon the direction of the osmotic gradient across the skin rather than upon the value of the osmolarity compared to normal body fluids. Experiments with a series of six polyhydric alcohols from methanol to mannitol and the polysaccharides, sucrose and raffinose, showed adonitol with 5 carbons to decrease the potential the most. Smaller and larger compounds of this set gave lesser effects. As yet no consistent explanation of the effects is forthcoming, but their demonstration calls for caution in the indiscriminate use of solutes such as mannitol or sucrose to make up the osmolality and in the neglect of urea because it penetrates freely. (auth)

31108 A STUDY ON THYROID FUNCTION USING RADIOISOTOPES IN CHILDREN. PART I. A STUDY ON I^{131} THYROID UPTAKE IN KOREAN CHILDREN. Chang-ran Rhee. J. Korean Med. Assoc., 6: 266-79(Mar. 1963). (In Korean)

Normal values for erythrocyte uptake of ^{131}I-triiodothyronine were determined in various age groups of 269 children and 41 adults of both sexes. The data were compared with data from thyroid ^{131}I uptake studies, basal metabolic rate measurements, protein-bound ^{131}I conversion ratios, and serum cholesterol levels. The results of the erythrocyte ^{131}I-triiodothyronine uptake studies showed good correlation with data from other methods of measurement of thyroid function in both children and adults with thyroid diseases. The data showed a hyperfunctional thyroid state in infants under two years of age and a statistical difference on the basis of sex apparent at 12 to 14 years of age. The erythrocyte uptake of ^{131}I-triiodothyronine is recommended as a simple and accurate method for use in the evaluation of thyroid function in children. (C.H.)

31109 LONG-TERM ADMINISTRATION OF DTPA FOR PLUTONIUM ELIMINATION. A FOLLOW-UP STUDY IN ONE PATIENT. W. Daggett Norwood (General Electric Co., Richland, Wash.). J. Occupational Med., 4: 130-2(Mar. 1962).

The average daily urinary output of plutonium was increased initially by a factor of 55 by the intravenous administration of DTPA to an employee who had received a body deposition of about 0.4 μc 30 months previously. As treatment was continued, intermittently, the effectiveness gradually decreased until at the end of 50 weeks it was only 20 per cent of that initially observed. However, when therapy was stopped for several months and then resumed the daily output of urinary plutonium was again increased to approximately the initial value attained with therapy. Alkalization of the urine produced apparently no change in the therapeutic effectiveness of DTPA in this case. The effectiveness of DTPA in increasing plutonium output in feces was likewise enhanced by the long period without therapy. (auth)

31110 INDICATION OF Sr^{90} CONTENT IN THE HUMAN ORGANISM BY ITS ACCUMULATION IN TEETH. E. I. Yartsev. Med. Radiol., 9: No. 4, 36-41(Apr. 1964). (In Russian)

The problem concerning the use of extracted teeth of adults for the evaluation of radiostrontium content in the skeleton is discussed. Experimentally established values of normalization coefficients, characterizing the correlation between the levels of isotope deposition in the teeth and skeleton are presented. The correlation does not depend on the geographical area where the persons reside and does not change with age in persons over 20 years old. It is supposed that there is no essential difference in the levels of radiostrontium accumulation in carious and intact teeth. (auth)

31111 THE USE OF THE IFKB METHOD TO DETERMINE INDIVIDUAL AND DOSIMETRIC CONTROL. V. Ya. Golikov and I. P. Korenkov (Sechenov Inst. of Medicine, Moscow). Med. Radiol., 9: No. 4, 53-5(Apr. 1964). (In Russian)

The results of individual dosimetric investigations on the irradiation of hands are presented. The data derived revealed a number of peculiarities in the distribution of the dose field on the body surface. The method is recommended for practical use. (P.C.H.)

31112 THE INFLUENCE OF UNITHIOL ON THE COURSE OF ACUTE URANIUM INTOXICATION. A. I. Ivannikov. Med. Radiol., 9: No. 5, 45-50(May 1964). (In Russian)

In experiments on albino rats studied the influence of unithiol on the excretion of uranium from the organism and on the course of acute uranium intoxication caused by subcutaneous administration of a 0.5 per cent water solution of uranyl nitrate. The employment of unithiol one hour after poisoning showed that the preparation does not accelerate the uranium excretion from the organism and exerts insignificant influence on its deposition in the kidneys. However, unithiol causes a redistribution of uranium in the organism augmenting its accumulation in the skeleton. The early use of unithiol (one hour after poisoning) produces a 30 per cent reduction of the lethality of rats caused by the introduction of uranyl nitrate (5 mg/kg), this apparently being the result of its normalizing effect on the metabolic processes. In unithiol treatment one day after intoxication, as well as in increase of the dose of uranyl nitrate up to 10 mg/kg, unithiol demonstrated no protective effect. Histological investigations revealed that unithiol produces a more diffuse involvement of renal tubules in the necrotic process. (auth)

31113 STUDIES ON REMOVAL OF RADIOACTIVE CONTAMINATION. II. REMOVAL OF Ca^{45} AND Sr^{90} BY ORAL ADMINISTRATION OF ETHYLENEDIAMINETETRAACETIC ACID IN RAT. Keiichi Masuda (Nara Medical Association, Japan). Nara Igaku Zasshi, 14: 138-42(Dec. 1963). (In Japanese)

The effect of oral administration of EDTA upon the removal of ^{45}Ca and ^{90}Sr from bone was studied with rats. Fecal excretion of these isotopes was increased after the oral administration of Na-EDTA. Similar results were also observed after injection of an excessive dose of vitamin D. When these treatments were simultaneously applied, the effects were further strengthened. (auth)

31114 RATE AND EXTENT OF LABELLING OF BOUND PHOSPHOHISTIDINE AS RELATED TO ITS ROLE IN MITOCHONDRIA. Loran L. Bieber, O. Lindberg, J. J. Duffy, and P. D. Boyer (Univ. of California, Los Angeles). Nature, 202: 1316-18(June 27, 1964).

A critical examination of ^{32}P labeling rates of mitochondrial fractions are reported. It is shown that the findings of Slater et al., do not allow exclusion of bound phosphohistidine as an intermediate in oxidative phosphorylation. Data pertinent to definition of the metabolic role of phosphohistidine are briefly discussed. (H.M.G.)

31115 INFLUENCE OF AGED DIFFERENCES ON THE UPTAKE AND EXCRETION OF RADIOISOTOPES. Kenshi Katayama (Kumamoto Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1152-61(Jan. 25, 1963). (In Japanese)

A review of the literature shows that the degree of radiobiological reactions is often dependent on the age of the

experimental animals used. In biological experiments more sensitive measurements on certain events can be performed by employing radiobiological techniques than biochemical methods. It is suggested that, particularly in the tracer experiments, the influence of age of the animals on experimental parameters should be assessed. In attempts to evaluate to what extent the differences in age of the subjects may influence the metabolism in vivo and the accumulation or excretion of radioisotopes, the pertinent literature was reviewed. Data relating to human isotope metabolism are also surveyed. (BBB)

31116 EXPERIMENTAL STUDIES FOR RADIOGRAPHIC CONTRASTING OF PANCREAS. I. DISTRIBUTION OF Zn-65 IN PANCREAS. Kazuo Inamoto, Giichi Yoshii, et al. (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1145-9(Jan. 1964). (In Japanese)

Zinc-65 chloride solution was injected intraperitoneally into male adult rats. At 3, 6, 12, 24, 48 hours and 7 days after injection, animals are anesthetized and sacrificed. Main organs were quickly removed and the general distribution of ^{65}Zn in each organ was measured. There was an initial uptake of ^{65}Zn by the liver, pancreas, kidney, and small intestine, but this was excreted or redistributed in time. In order to examine the distribution process of ^{65}Zn in a short period more precisely, hourly studies were carried out on some abdominal organs from 1 to 10 hours after injections. Injected ^{65}Zn appeared in high concentrations in the pancreas and small intestine at 3 and 7 hours, respectively. The chronological variation of ^{65}Zn uptake in the liver was less than in the pancreas. The blood contained the lowest concentrations of the organs studied. In another experiment ^{65}Zn chloride solution was administered orally. At 4, 7, 24, 48 hours and 7 days after administration the pancreas was quickly removed and fractionized into cellular components, that is, nuclei, zymogen granule, mitochondria, and microsome, by centrifuging. In the initial period after administration, the zymogen granule concentration was higher than the other three components. In 7 hours after administration the zymogen granule concentration decreased rapidly. Both the mitochondria and microsome concentration at this time were the highest through the 7 days observation. ^{65}Zn in the above components remained until the 48-hour observation. (auth)

31117 STUDIES ON THE TRANSLOCATION OF FOLIAR-APPLIED Cs^{137} AND P^{32} IN VITIS VINIFERA L. Valo Eynard. Nuovo Giorn. Botan. Ital., 68: 393-8(1961). (In Italian)

Cesium-137 and ^{32}P were simultaneously applied to four apical leaves on one branch of Emperor grape seedling characterized by two twin identical shoots. The samples harvested 24 hr after (from the treated branch), showed that the ratio of ^{137}Cs and ^{32}P decreased, pointing out different and independent rates of translocation in the phloem, 48 hours after treatment. In the leaves taken from the untreated branch and in the root, the ratio was almost constant. (auth)

31118 EXCRETION OF NIOBIUM-95, YTTRIUM-91, CERIUM-144, AND PROMETHIUM-147 IN GOATS. Lars Ekman and Bertil Aberg (Royal Veterinary Coll., Stockholm). Res. Vet. Sci., 2: 100-5(Jan. 1961).

When ^{95}Nb, ^{91}Y, ^{144}Ce, and ^{147}Pm were administered orally in 100- to 200-μC amounts to goats, the major route of elimination was via the gastrointestinal tract. About 0.05 to 0.3% of the dose administered was excreted in the urine and 0 to 0.3% in the milk during the 10 days following administration. In the milk ^{95}Nb was never detected. Cerium-144 was excreted in the milk in slight amounts; the total excretion during the first week amounted to 0.003% of the dose administered, but during the second week no Ce could be detected. Promethium-147 was present in the milk during the second day after administration (0.002% of the dose) and could not be detected thereafter. Yttrium-91 after oral administration was present in the milk to the extent of 0.0015% of the dose during the second and third day after administration; after that time it was not detectable. Urinary excretion of all radioisotopes administered could be summarized as follows: between the second and third day after administration the highest concentrations occurred. During the first 7 to 9 days a total amount of 0.05 to 0.14% of the dose administered was excreted via the kidneys. In no case were any detectable amounts of radioactivity found in the urine after 9 days. Fecal excretion predominated for all the radioisotopes. The maximal excretion occurred on the second and third days, and no detectable amounts were found after 9 days. Between 94.2 and 111.5% of the dose administered was found in the feces. After intravenous administration of ^{91}Y, it was found that during a 10-day period 1.10% was excreted in milk, 20.06% in urine, and 3.93% in feces. The peak concentration in milk occurred 6 hr after intravenous administration. From a goat which received ^{91}Y intravenously, cartilage from the trachea and the ribs was dissected free and the chondroitin sulfuric acid isolated. Out of five preparations of chondroitin sulfuric acid, three showed radioactivity. In milk and blood serum samples from goats which received ^{91}Y intravenously, no diffusible radioactivity was detected. (BBB)

31119 RADON, CELLULAR RESPIRATION, AND THE ANS [AUTONOMIC NERVOUS SYSTEM]. W. Frey Schweiz. Med. Wochschr., 93: 1535-8(1963).

The inhalation of Rn in average concentrations of 2.4×10^{-11} C/l induced tissue dysoxia. This lead, by way of the chemoreceptors of the carotid sinus and the arch of the aorta, to a compensating increase in blood flow throughout the body, a rise in blood pressure and in pressure amplitude, and elevation of cardiac stroke volume reflecting increased sympatheticotonia. These reactions were reversible, but they placed a strain on autonomic nervous function. Radon concentrations of more than 10^{-11} C/l, such as may be present in air from the soil and in badly insulated cellars, are harmful to the entire nervous system and diminish the individual's capacity for work. Prolonged inhalation of air with a high Rn concentration can lead to an increase in long-lived radioactive metabolic products and to organic damage. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31120 ENZYMATIC CONVERSIONS IN TRITIUM WATER. I. PREPARATION OF SPECIFICALLY T-LABELED L-LACTIC ACID FROM HTO BY MEANS OF COUPLED ENZYME REACTIONS. Martin Wenzel and Theodor Guenther (Freie Universität, Berlin). Z. Physiol. Chem., 333: 286-96(1963). (In German)

The formation of lactic acid labeled with ^{3}H in the 2 position was carried out by a sequence of enzymatic reactions: fumarate hydrogenase was used to prepare malate from fumarate, malate was oxidized with NAD (nicotinamide adenine dinucleotide) and malate dehydrogenase to give NADH and oxalacetate, and this NADH was used to produce lactate from pyruvate with lactate dehydrogenase. These reactions were adaptable in HTO to the production of labeled lactate. The apparatus for the labeling procedure is described and illustrated. A volume of 0.95 ml of solution 0.033M in phosphate buffer, pH 7.3, containing

3.2 mg disodium fumarate, 0.7 mg NAD, 100 μg crystallized fumarate hydrogenase, 100 μg lactate dehydrogenase, and 25 μg malate dehydrogenase was freeze-dried, and 0.95 ml HTO distilled into it. This was allowed to stand 30 min at 22°C; then 0.2 ml 0.033M phosphate buffer, pH 7.3, with 0.55 mg Na pyruvate was pipetted into it. After four hours 90 to 100% of the pyruvic acid was converted to lactic acid. The HTO was distilled off and 1 ml 3% $HClO_4$ added. After the precipitate was centrifuged and dried, the labeled fumaric, malic, and lactic acids were separated by paper chromatography, using Schleicher & Schuell 2043b, ascending, ethyl alcohol-25% ammonia-H_2O (20 : 1 : 4), for 16 hr at 10°C, giving the following R_f's: malic, 0.19; fumaric, 0.24; succinic, 0.31; lactic, 0.59; oxalacetic, 0.07. Radioactivity was measured directly and on the eluted acids; the yield of lactic acid was 6.5 μmol/7.5 μmol pyruvate, act. equaled 0.64 μC/μmol from 0.89 μC/μmol H-atom HTO. Oxidation of the labeled acid to acetic acid is also described. (BBB)

31121 ORGANIZATION OF SURVEYS FOR RADIONUCLIDES IN FOOD AND AGRICULTURE. Report on an FAO Expert Committee Rome, 12-18 (July 1961). FAO Atomic Energy Series No. 4. Rome, Food and Agriculture Organization of the United Nations, 1962. 112p.

The report of a Food and Agriculture Organization (FAO) Committee sets out the principles involved in the organization of surveys for radionuclides in food and agriculture and gives guidance on the design and conduct of such surveys. The report indicates methods with which various types of surveys of radioactivity in, the human diet may be efficiently carried out. However, no attempt is made to evaluate the need for initiating or extending general surveys which are related to widespread fallout from weapon testing. (auth)

31122 VOPROSY FIZIOLOGII. TOM III. (Questions of Physiology. Volume III). A. I. Karaev, ed. Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1960. 118p.

Fourteen papers are included. A separate abstract was prepared for one. Papers not abstracted are on the effects of interoceptive stimulus of mammary glands in goats on the biochemical blood picture, the effects of cobalt, manganese, and copper on the morphology of young birds, and other problems of animal and human physiology. (M.J.T.)

31123 VOPROSY FIZIOLOGII. TOM IV. (Questions of Physiology. Volume IV). A. I. Karaev ed. Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1960. 136p.

Sixteen papers are included. A separate abstract was prepared for one. Papers not abstracted are on the course of physiology research in Azerbaijan, and effects of various stimulations — hypothermy, receptor stimulus of stomach and rectum, and others — on the contents of the blood or the course of various infections in horses, cattle, dogs, buffalo, and other animals. (M.J.T.)

31124 VOPROSY FIZIOLOGII. TOM V. (Questions of Physiology. Volume V). A. I. Karaev, ed. Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1962. 178p.

Fifteen papers are included. Separate abstracts were prepared for two. Papers not abstracted are on effects of stimulations on the heart, stomach, blood contents, muscles, and interoceptive exchange reflexes in buffalo and other animals. (M.J.T.)

For abstracts of individual papers see: 31254 and 31255.

Radiation Effects

31125 (CEA-R-2320) CONTRIBUTION A L'ETUDE DU POUVOIR LEUKEMOGENE DES RADIATIONS UTILISEES EN RADIODIAGNOSTIC CHEZ L'ENFANT: ETUDE STATISTIQUE DES PRINCIPAUX EXAMENS RADIOLOGIQUES SUIVANT L'AGE ET LE SEXE. (Contribution to the Study of the Leukemia Potential of Radiation Used in Radio-Diagnostics in Children — Statistical Study of the Main Radiological Examinations According to Age and Sex). Bernadette Larcher (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1964. 63p.

Thesis submitted to Université, Paris.

A survey was made of the distribution by sex and age of 13,596 diagnostic radiologic examinations on children. The results will be used in a study of pathologic conditions that may develop in the group, with emphasis on any increase in the incidence of leukemia or cancer following low-dose radiation exposure. The survey showed that the frequency of radiologic examinations in the diagnosis of digestive and urinary disturbances is very high in babies under one year of age, and the frequency is higher in boys than in girls. (C.H.)

31126 (EUR-1610.f) COMPARAISON DES EFFETS DE DIFFERENTS AGENTS MUTAGENES PAR L'ETUDE DE LA MUTAGENESE DE QUELQUES PLANTES-TYPES. (Comparison of the Effects of Various Mutagenic Substances by Studying the Mutagenesis of Some Typical Plants). P. Dommergues and J. Gillot (France. Institut National de la Recherche Agronomique, Paris). 1964. 12p.

The mutagenic effects of the ethyl ester of methanesulfonic acid and gamma radiation on pears, roses, carnations, lettuce, poppy, wheat, and corn were compared. These plants represent specimens with vegetative reproduction, sexual reproduction, and diploid and allogamic reproduction. The results are tabulated and briefly discussed. (J.S.R.)

31127 (EUR-1809.f) VARIATION DE LA REACTION DES BOUTURES D'OEILLET A L'IRRADIATION GAMMA. (Variation in the Reaction of Carnation Cuttings to Gamma Radiation). P. Dommergues (France. Institut National de la Recherche Agronomique, Paris) and J. Gillot (European Atomic Energy Community). 1964. 14p. (CONF-551-1)

From Technical Meeting on the Use of Induced Mutations in Plant Breeding Programs, Rome, May-June 1964.

The American carnation variety White Sim is a periclinal chimera which occasionally bears petals with red sectors. In order to study the action of ^{60}Co gamma rays on the uncovering of deep chimerical tissue, young rooted cuttings in White Sim were irradiated at a stage when the lateral buds were generally not yet in development. One experiment was carried out in July 1961 and another in October 1962. In the first, the principal flowers yielded an uncovering rate of deep tissues superior to that of lateral flowers. The contrary was observed in the second experiment. These contradictory observations are probably due to differences in the physiological status of the buds. (auth)

31128 (LADC-6472) OBSERVATIONS ON LIFE SPAN, RADIORESISTANCE, AND PRODUCTIVITY IN OFFSPRING FROM 5 TO 25 GENERATIONS OF X-IRRADIATED MALE MICE. J. F. Spalding, Mary Brooks, and Paul McWilliams (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract [W-7405-eng-36]. 22p. (CONF-590-1)

From Symposium on Genetics, Bar Harbor, Me., June–July 1964.

Male mice were exposed to 200 rads of x rays (acute whole-body exposures) for 30 consecutive generations. Comparative studies on productivity of mice from 5, 10, 15, and 20 generations of x-irradiated males showed a consistent decrement in many litter and breeding characteristics but also showed that irradiated line mice produce more litters and have a longer fertile life. Life span studies of offspring and grandoffspring from 5 through 15 generations of x-irradiated sires showed no reduction in survival that can be attributed to irradiated ancestry. A radioresistance decrement in irradiated line mice after 10 generations of x-irradiated sires persisted through the 25th generation, and the genetic nature of this decrement is still in question. (auth)

31129 (NYO-2761) ATLAS OF CURRENT ROENTGENOGRAPHIC FINDINGS IN THE NEW JERSEY RADIUM CASES. Lester A. Barrer, Carye-Belle Henle, Robert Bonda, and Hyman W. Fisher (New Jersey. State Dept. of Health, Radium Research Project, West Orange). Oct. 1963. Contract AT(30-1)-2181. 72p.

Annotated roentgenograms are presented of bone which are illustrative of the bone changes currently encountered in a group of individuals with body burdens of ^{226}Ra and ^{228}Ra. The terminology used to describe these changes in a study of individuals under investigation by the Radium Research Project of the New Jersey State Department of Health in the course of its epidemiological follow-up of Ra cases is discussed. The bone changes illustrated are representative of findings currently observed and include destruction of bone; disturbance of articular aspect; cortical, trabecular, and periosteal changes; sclerosis; discrete radiolucencies; and fractures. With thorough clinical and laboratory studies, specific etiologies for these bone changes, other than Ra or aging, have been excluded. (auth)

31130 (ORNL-P-85) PHOTOCHEMISTRY OF NUCLEIC ACIDS, AND ITS BIOLOGICAL IMPLICATIONS. John Jagger (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 35p. (CONF-611-1)

From the 4th International Photobiology Congress, Oxford, July 1964.

The present state of knowledge of ultraviolet action in biology is discussed. A review is presented of the biological implications of the known photochemistry of nucleic acids. Eight papers are discussed in detail which treat uv effects on RNA, protein involvement in uv damage to cells, and recovery from uv damage to DNA. The problem of combining uv photochemistry of the nucleic acids with uv photobiology is considered. (D.L.C.)

31131 (RRA-T42) IONIZING IRRADIATION AND ITS EFFECTS UPON HEALING WOUNDS. Annual Progress Report, January 1, 1963–December 31, 1963. B. L. Reynolds (Radiation Research Associates, Inc., Fort Worth, Tex.). Contract DA-49-193-MD-2368. 84p. (AD-430359)

Radiation injury from exposure of 100 to 1000 r in albino rats produced changes in chemical parameters of body tissues that appear to be phasic in character, particularly in striated muscle, lung, areolar connective tissue, and liver. Even in those animals that did not survive exposure to total-body irradiation, the phasic phenomenon was observed, although reduced in quantity and frequently in quality of the response. Comparison was made to other forms of injury in which changes in chemical parameters were seen to behave in like fashion, with the phasic phenomenon. Examinations of striated muscle in animals subjected to total-body irradiation allowed an appraisal with respect to phasic occurrence, such that gradation of response to the total trauma was suggested. Suggestions for therapy are presented that are based upon the gradation response. A critique of the methodology in sampling, analysis, and interpretation is offered for a more realistic appraisal of this and related work. (auth)

31132 (JPRS-25233) THE EFFECT OF RADIATION ON THE RNA AND RNA METABOLISM IN CELLS OF A HUMAN MALIGNANT TUMOR. E. (Ye.) V. Budnitskaya, M. Brunfaut, and M. Errera. Translated from Vopr. Med. Khim., 10: No. 2, 179-84(1964). 8p. (TT-64-31550)

The uptake of ^{3}H-labeled cytidine by RNA of x-irradiated and nonirradiated HeLa cells in culture was studied by autoradiographic methods. HeLa cells in the log growth phase were incubated with ^{3}H-cytidine before irradiation and fixed immediately, or the incubation was continued in a nonradioactive medium, or irradiated cells were transferred to labeled medium. Results indicated that rapidly formed RNA is most sensitive to irradiation immediately after it is formed and that nucleolar RNA is even more radiosensitive than the rest of the nucleus; a recovery of synthetic activity occurs as early as one hour after irradiation; and that radiation inhibits the migration of RNA from the nucleus into the cytoplasm. (C.H.)

31133 (JPRS-25274) ANTI-RAY EFFECT OF GALLATES UNDER CONDITIONS OF IRRADIATION WITH 100 ROENTGENS. V. A. Baraboy. Translated from Fiziol. Zh., Akad. Nauk Ukr. SSR, 10: No. 1, 89-93(1964). 7p. (TT-64-31569)

A thousand-roentgen irradiation of mice under the conditions of the experiments calls forth a severe form of acute radiation sickness, which results in the death of all the animals 8 to 10 days after irradiation (average survival time 5.6 ± 0.21 days). Administration of cysteamine (mercamine) 5 to 15 min before irradiation has no marked effect on the course of radiation trauma. Administration of propyl gallate and sodium gallate before irradiation causes a very definite increase in the average survival time of the mice by 2 to 3.5 days, i.e., approximately by a factor of 1.3 to 1.7. Propyl gallate and sodium gallate give a definite therapeutic effect when administered immediately after irradiation and prolong the mice's lives by 2.4 to 2.6 days, i.e., approximately by a factor of 1.5. Butyl gallate, which has a considerable antiradiation action under conditions of minimum absolutely lethal dose irradiation, had no effect on the course of radiation trauma caused by irradiation with 1000 r. This is apparently connected with its low solubility. (auth)

31134 (OTS-63-11456/1(p.37-41)) THE INFLUENCE OF GAMMA RADIATION WITH ^{60}Co ON THE URINARY EXCRETION OF FREE AMINO ACIDS IN RATS. M. Jovanovic and N. Svecenski. Translated from Acta Med. Iugoslav., 17: No. 1, 46-52(1963).

The influence of γ radiation on the urinary excretion of free amino acids was investigated in rats. Urine was collected periodically for 48 hr after exposure and ethanol extracts were analyzed by paper chromatographic methods. Results showed that rats normally excrete serine, glycine, threonine, and alanine in the urine, and up to a dose of 500 r γ radiation no change in amino acid excretion was noted. Above doses of 500 r, asparagine, β-aminoisobutyric acid (BAIBA), cystinic acid, and leucine were also excreted and serine was not excreted. No new qualitative changes were noted on the second day after irradiation. It is concluded that the appearance of BAIBA in the urine

after radiation exposure signifies an increased catabolism of thymine as its direct predecessor, and an increased catabolism of thymine points to an increased destruction of desoxyribonucleic acid. It is suggested that in the treatment of radiation injury by transplanting bone marrow, detection of BAIBA in urine can be used as an indicator for time of rejection of the transplant. (C.H.)

31135 STUDY OF THE ACTION OF RADIATION ON MACROMOLECULAR POLYELECTROLYTES. IV. RADIOLYTIC DEGRADATION OF PROTEINS. Gh. Furnică and A. Dimitriu. Acad. Rep. Populare Romine, Studii Cercetari Biochim., 6: 411-19(1963). (In Romanian)

The effect of cobalt-60 gamma radiation on serum albumin in 0.5% aqueous solution and on solid albumin was studied. The quantitative chromatogram of the amino acids obtained by total or partial hydrolysis of the serum albumin was examined. Results showed radiation effects at the level of the inter- and intra-peptide bondings. The radiation also determined the process of transformation of the amino acids in the polypeptide chain. Chemical bonds linking amino acids of the type found in serine, proline, cystine, and leucine were rendered labile by irradiation. Latent modifications, appearing some time after irradiation, were also induced. (tr-auth)

31136 STIMULATING INFLUENCE OF SMALL-DOSAGE GAMMA IRRADIATION ON PLANT METABOLISM. B. I. Pozsar (Agriculture Experimental Inst., Iregszemcse, Hungary). Acta Biol. Acad. Sci. Hung., Suppl. 5: 33-4(1963).

From the effect of small doses (0.5 to 5.0 kr) of γ irradiation (^{60}Co) considerable stimulation can be demonstrated in the ontogeny of plants. After irradiation of dehydrated seeds the phenologic phases of plants are shortened, the physiologic basis of which may be correlated with the stimulation of metabolic processes. There is a 15 to 20% increase in the dry matter under the effect of a small dose of γ irradiation, particularly in the initial stages of the vegetative development. Stimulation of the intensity of metabolic processes is higher in the early developmental stages than later. The ion uptake capacity in legume seedlings, irradiated with a small dose in dehydrated state of seeds, increases two to five times in comparison with the controls. The incorporation of $^{35}SO_4$ into the protein fraction of leaves increases by 50 to 120%, which reflects metabolic activity. The incorporation of $^{32}PO_4$ into organic compounds is, in the initial stages of vegetative development, two to three times more rapid in the irradiated plants than in the controls. The primary causes for the increase of metabolism intensity induced by a small dose of γ irradiation consist in the rise of hydration. In wheat varieties the rise of hydration under the effect of small-dosage irradiation ranges between 4 to 6%, as consequence of which increases of mineral nutrition and the synthesis of organic matters ensue. The increase of metabolism induced by a low-dosage irradiation is probably accompanied by a stimulation of cell respiration and by energy transfer processes. (BBB)

31137 AMINO ACIDS OF THE BLOOD IN ACUTE RADIATION SICKNESS. M. Podil'chak, L. Kuzmenko, D. Makar, E. Yurmin, V. Chepovskii, and V. Pobegailo. Acta Biol. Med. Ger., 12: No. 1-2, 137-46(1964).

Dynamics of changes in the amino-acid content of blood plasma of rabbits irradiated with x rays in doses of 800 (LD_{min}) and 1100 r (LD_{50}) were investigated. The concentration of some amino acids, particularly lysine and cystine, increased by a factor of 2 to 3 versus controls in the course of radiation sickness. The increase in concentration of other amino acids, histidine, arginine, phenylalanine, methionine, and valine, was less pronounced. The greatest increase in concentration of amino acids took place at the height of radiation sickness. The levels of tyrosine and phenylalanine decreased at the height of radiation sickness and remained at a low level versus controls until recovery of the animals. The concentration of glycine, serine, and aspartic acid rose gradually after irradiation and dropped after the 23rd day, reaching a lower level than that for control animals. There were no significant changes in the concentration of leucine or isoleucine. The changes noted were more pronounced on irradiation with 1100 than 800 r. The increase in the concentration of the majority of the amino acids investigated was considered to be caused by protein starvation and a negative nitrogen balance in the irradiated organism, as a result of which deterioration of the protein structures of a number of organs and tissues took place and endogenic protein nutrition increased. (OTS)

31138 HEAVY-PARTICLE IONIZATION (He, Li, B, Ne) AND THE PROLIFERATIVE CAPACITY OF NEOPLASTIC CELLS "IN VIVO." K. Sillesen, J. H. Lawrence, and J. T. Lyman (Univ. of California, Berkeley). Acta Isotopica, 3: 107-26(1963).

The relative biological effect of several heavy particles with various energies, nuclear mass, and charge was studied in two mouse neoplasms in an attempt to determine the mechanism of action of densely ionizing radiation. Cultured lymphoma and mammary carcinoma cells in thin chambers were bombarded with α particles, deuterons, ^{7}Li, ^{11}B, or ^{20}Ne ions. Results were compared with those obtained with x radiation. It was concluded that the Bragg-peak ionization produced by 910-Mev α particles has a greater RBE than the plateau region of ionization as measured by the proliferative capacity of neoplastic cells grown in the living animal after irradiation. Preliminary results in the same system using various heavy particles producing various LET's indicate that disappearance of the oxygen effect requires a very high LET. Further studies are necessary to define the z number and energy of the particle with optimal characteristics based on width of the Bragg peak, absence of oxygen effects, and RBE. Implications of the findings in radiotherapy are discussed briefly. (C.H.)

31139 EFFECT OF X-RAYS ON HeLa CELL RIBONUCLEIC ACID (RNA). E. V. Boudnitskaya, Maximilienne Brunfaut, and M. Errera (Universite, Brussels). Arch. Intern. Physiol. Biochim., 71: 810-11(1963). (In French)

Radiation effects on RNA in HeLa cells were studied by irradiation before and after exposure to cytidine-^{3}H. The incorporation of the labeled cytidine in RNA and DNA was determined by autoradiography. Radiation was found to reduce uptake into RNA and this effect was most marked after short exposures to cytidine. Transfer of the tritium from the nucleus to cytoplasm was inhibited by radiation. (M.C.G.)

31140 RESPONSES OF NEONATAL RAT SPINAL CORDS TO HIGH ENERGY PROTONS. Shirley Ann Gilmore (Uppsala Univ.). Acta Radiol. (N.S.), 2: 81-94(Apr. 1964).

High-energy protons directed through lumbar spinal cords of rats 3 to 16 days old resulted in a high incidence of neurologic abnormalities regardless of age at time of irradiation. These changes are compared and discussed in relation to work with roentgen irradiation. The histopathology of these cords is described. Studies of spinal cords of rats irradiated when 3 days old and killed 2 to 11 days later showed a marked decrease in the quan-

tity of neuroglia and a consequent hypo- or amyelination. These rather selective alterations are compared with late, non-specific histopathologic changes in the cords described above. (auth)

31141 RADIATION-INDUCED CHROMOSOME ABERRATIONS. PERSISTING ABERRATIONS IN LONG-TERM CULTURES FROM HUMAN SKIN IRRADIATED IN VIVO. Jakob Visfeldt (University Inst. for Human Genetics, Copenhagen). Acta Radiol. (N.S.), 2: 95-108(Apr. 1964).

A small area of a patient's forearm was exposed to 100 r to investigate whether cells presenting chromosome aberrations attributable to radiation in vivo persisted in long-term cultures. Skin biopsies were taken at intervals after exposure and cultured for up to about five weeks. Several aberrations, mostly translocations, including pericentric inversion, deletions, and an abnormal distribution between the chromosome groups, were detected. It appeared that cells with certain aberrations were capable of reproduction by mitotic division. (auth)

31142 THE RESPONSE OF THE DOG TO HEAD IRRADIATION. W. J. Quinlan and S. M. Michaelson (Univ. of Rochester, N. Y.). Aerospace Med., 35: 362-4(Apr. 1964).

Dogs received head exposure to 1 Mev x rays at doses of 5,000, 10,000, or 25,000 r. At 5,000 r, there was no evidence of neurological change. Survival time was greater than thirty days. Ten thousand r resulted in transient vomiting and disturbance in equilibrium. Death occurred at approximately two weeks. Marked central nervous system disturbance with motor incoordination, convulsions, and death within 24 hours resulted from exposure to 25,000 r. (auth)

31143 THE INCREASE IN INDUCED MUTATION FREQUENCY AFTER FRACTIONATED IRRADIATION OF GONIAL CELLS OF THE SILKWORM. Yataro Tazima and Akio Murakami. Ann. Rept. Natl. Inst. Genet. (Japan), No. 13, 87-9(1962). (A/AC.82/G/L.926)

Silkworms were given single and fractionated 1000 r x-ray doses. Mutation frequency was estimated during the early larval stage from the 7th to 9th day after hatching by the specific locus method of pe and re loci. Higher mutation frequencies were found in groups given fractionated irradiation than in the single shot groups. Results also suggest that fractionated irradiation with 24-hr intervals between fractions is more effective than with 48-hr intervals. However, interval shortening proved to have a limit. (H.M.G.)

31144 CALCULATIONS CONCERNING THE RESPONSE OF HUMAN CELLS IN TISSUE CULTURE TO X IRRADIATION AT VARIOUS OXYGEN CONCENTRATIONS. A. A. van Soestbergen (TNO, Rijswijk, Netherlands). Antonie van Leeuwenhoek J. Microbiol. Serol., 28: 405-10 (1962).

It has been demonstrated, using Pseudomonas aeruginosa as the test subject, that the relation between the magnitude of the response produced by a given fixed value of the x-ray dose (r) and the logarithm of the O concentration (x) can be described by an equation, the derivation of which is presented. The equation allows calculation of the parameter which represents the fraction of bacteria surviving a radiation dose r applied in the presence of an O concentration x. The relation described by the equation was established in cases where the dose survival curve is approximately linear on a semilogarthmic plot and where a curve resembling the multihit type of curve is obtained. It was shown that the simple transformation of the equation of a cumulative normal curve obtained by substitution of the expression for $(1-P_x)_r$ adequately describes the relation between the fraction of surviving cells and the O concentration in irradiation experiments on the reproductive integrity of human cells in tissue culture. The calculations presented are based upon data presented by Barendsen concerning the ability of kidney cells of human origin subjected to x irradiation to produce clones when plated on culture dishes containing a suitable medium. The data of Barendsen were analyzed according to the method of maximum likelihood which is based upon the probit transformation of the fraction of surviving cells. The calculations for 600 rad are tabulated, and the data obtained by Barendsen for a dose of 1000 rad were also subjected to analysis. The results showed that the data derived in an experiment with human kidney cells subjected to a dose of 600 or 1000 rad can be represented by a simple transformation of the equation of a cumulative normal curve if the fraction of surviving cells is plotted against the logarithm of the oxygen concentration. It is concluded that data describing the damage to the reproductive capacity of human cells in tissue culture by ionizing radiation do not conflict with the hypothesis that the fractions of surviving cells and the log oxygen concentration can be adequately represented by the equation of a cumulative normal curve between the limits $(1-P_M)_r$ and $(1-P_N)_r$. (BBB)

31145 THE ACTIVITY OF RED CELL CARBONIC ANHYDRASE IN THE ACUTE POST-RADIATION DISEASE OF RABBITS. Kazimierz Marek and Stanislaw Kośmider. Arch. Immunol. i Terapii Doswiadczalnej, 8: 513-17(1960). (In Polish)

Rabbits were exposed to doses of 500, 700, or 1,000 r x radiation and measurements were made of erythrocyte carbonic anhydrase activity during the first 24 hr post-irradiation and at intervals for four weeks or up to death. All rabbits showed a reduction in carbonic anhydrase activity during the first 24 hr after irradiation. No correlation was established between dose and the degree of anhydrase inactivation. No decrease of enzyme activity resulted when blood was irradiated in vitro. (C.H.)

31146 RESEARCH ON REASSOCIATION IN VITRO OF EPITHELIUM AND MESENCHYME OF EMBRYONIC MOUSE LUNG AFTER TRYPTIC DISSOCIATION AND IRRADIATION WITH GAMMA RAYS. Tommaso Alescio, Anna Cassini, and Mario Ladu (CNEN, Frascati, Italy and Università, Cagliari, Italy). Arch. Ital. Anat. Embriol., 1-44(1963). (RT/BI0(63)44). (In Italian)

Lungs of mouse embryos were explanted at the 11th day of gestation, separated by trypsinization into the epithelial tracheobronchial tree and fragments of mesenchyme, laid on a clot of chicken plasma and embryo extract and cultured for six days. It was observed that the pieces of mesenchyme, laid at some distance from the epithelium, move toward it and rapidly reached it, so that a single mass was formed. Later lumps of necrotic tissue were rejected, and the mesenchyme reorganized itself around the epithelium, forming well defined condensations around the epithelial buds. The epithelium, that had remained quiescent until then, resumed its morphogenetic activity and gave origin to a strongly ramified but rather a typical tracheobronchial tree. If, as soon as the two tissues were separated, either of them, or both, were submitted to irradiation by gamma rays from ^{60}Co, at the dose of about 320 rad, then recombined and cultivated with the same technique, the essential phenomena of the reconstitution of lung movement of mesenchyme toward epithelium and organization of mesen-

chyme, were not basically changed. However, the rejected necrotic masses were bigger and more numerous and the resulting organ was smaller than in the nonirradiated controls. There were differences in behavior of the epithelial branching in relation to irradiation of epithelium only, or mesenchyme only, or of both tissues. In the first case the ability of the epithelium to resume ramification was not significantly changed. Instead, it was much diminished if the irradiation was directed on mesenchyme. The most damaging intervention was the irradiation of both tissues, in which case a bronchial tree appeared again in only a small number of cultures. (C.H.)

31147 THE EFFECT OF X-RAYS ON PYRIDOXAL PHOSPHATE IN ESCHERICHIA COLI. H. Langendorff and H. Geyer (Universitat, Freiburg i. B.). Arch. Mikrobiol., 46: 1-8(1963). (In German)

The estimation of pyridoxal phosphate in Escherichia coli after irradiation is described. The investigations are made with resting and growing cells. A dose of 10, 40, or 80 kr does not change the pyridoxal content of the cell. In all cultures of E. coli starts the synthesis of pyridoxal phosphate at the same time on the end of the log-phase. (auth)

31148 EXPERIMENTAL AND THEORETICAL STUDIES OF THE RELATIVE BIOLOGICAL EFFECTIVENESS OF NEUTRONS. H. Krueger, E. H. Graul, and H. Hundeshagen (Philipps-Universitat, Marlburg/Lahn, Ger.). Atompraxis, 10: 278-86(June 1964). (In German)

Experiments on determination of the neutron dose from the $T(d,n)^4He$ reaction in total-body irradiation of mice are discussed. It was possible to determine the angular distribution of the intensity and the mean energy of the neutrons by threshold detector measurements. The effective deuteron energy was found to be 175 ± 20 kev at which the $T(d,n)^4He$ reaction was set off with a bombardment energy of 400 kev. The background of scattered fast neutrons in comparison with primary neutrons amounted to less than 1.5% at a target distance of up to 30 cm. Neutron flux density was determined to within ± 5% with $MgCl_2$ solutions. (auth)

31149 INFLUENCE OF X-RAYS ON SPROUT GROWTH AND MATERIAL CHANGES IN THE POTATO. E. Gantzer and F. Heilinger (Forschungsanstalt fur Landwirtschaft, Brunswick). Atompraxis, 10: 287-90(June 1964). (In German)

The influence of x rays on sprout growth and on changes in the contents of the tuber material was examined in two varieties of potato (one early, one medium-early). An increase in sprout weight was found following irradiation with low doses, depending on the variety and its state of physiological development. Medium doses (500 to 1000 r) caused the formation of side shoots in the sprouts, which likewise resulted in increased sprout weight. High doses (3000 to 4000 r) caused a delay in sprouting and also inhibited the growth of the sprouts. Significant changes in the sugar level (increase followed by decrease) were observed only after higher doses. This was also true of the prolin content, which was lower than that in the control plants (analogous to a delay in sprouting). The irradiation method, particularly the dose output, is of great importance. (auth)

31150 A NEW METHOD TO CONTROL INSECTS: USAGE OF RADIATION. Akif Kansu. Bitki Koruma Bulteni, 2: 40-60(1962). (In Turkish)

Results are reported from investigations on the use of radiation for the sterilization or killing of insect pests that attack farm animals and crops or infest stored food products. The release of sterile male insects to diminish and annihilate the population of certain species is discussed. This method resulted in eradication of the screw worm, Callitroga hominivorox, from the island of Curacoa. It was concluded that the use of direct radiation for killing insects is more practical, especially for insects that infest stored grain. Data are included from measurements of lethal and sterilizing radiation doses for insects. (C.H.)

31151 OBSERVATIONS ON THE EFFECT OF GAMMA RADIATIONS IN STRAINS OF MYCOBACTERIUM ISOLATED FROM HUMAN PULMONARY TUBERCULOSIS. José Mejia Chávez (Hospital Militar Central, Lima). Bol. Junta Control Energia At. (Peru), 8: No. 47, 60-7(Oct.-Dec. 1963). (In Spanish)

Strains of Mycobacterium tuberculosis, isolated from cases of human pulmonary tuberculosis, were exposed to ^{60}Co γ radiations in order to observe the biological modifications produced by sublethal doses both in the irradiated strains and in successive generations. Preliminary results on the bacteriological, immunological, and histopathological alterations in experimental tuberculosis with modified strains are reported. The techniques used are described. The results are tabulated and show that doses considered as sublethal caused a delayed lethal effect up to the third generation, as well as progressive degenerative morphological alterations. Immediate alterations of the enzymatic biochemical systems lasting up to the third generation were also observed. The strains exposed in aqueous solution had a greater radiosensitivity, and the catalyst enzyme was unstable to gamma radiation. (J.S.R.)

31152 THE COAGULATION OF BLOOD IRRADIATED IN VITRO. G. Caprino, G. Cittadini, and L. Maccioni (Universita, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 38: 1326-8(Dec. 31, 1962). (In Italian)

Measurements made by thrombodensitography and the use of glass equipment treated with silicones are reported, and it is contended that some of the discordant results concerning the effect of radiation on blood coagulation reported in the literature are due to different techniques of irradiation and of measurement. Blood samples were taken from adult humans, 5 ml of which was irradiated in a watch glass at once and centrifuged at 1000 rpm; 15 ml were first centrifuged at 1000 rpm, then divided into control and test plasmas, and another 15 ml was first centrifuged at 5000 rpm and treated similarly thereafter. The radiation doses were 500, 1000, 2000, 4000, and 32,000 r. No observable changes were noted after doses of 500 r; at 1000 and 2000 r hypocoagulability was observed for plasma obtained at 1000 rpm (recalcification time 115% of controls) and 5000 rpm (127% of control) but hypercoagulability for blood (85% control). After 4000 r there was hypocoagulability in all three samples, with increases over lower doses for the plasma samples; at 32,000 r the plasma samples showed increased hypocoagulability but complete hemolysis occurs in red blood. The prothrombin time remained within normal maximum limits except after 4000 and 32,000 r, when there was increasing prothrombin time. The change in factors V and VII was irregular; the data which seem more valid are those obtained with samples irradiated with 1000 to 2000 r. It is suggested that the liberation of a coagulation activator of the thromboplastin type may explain these results. (BBB)

31153 DEVELOPMENT IN VITRO OF THE CARTILAGE OF THE JOINT OF A RAT SUBJECTED TO GAMMA IRRADIATION. Angela Ghisellini and Mario Ladu (CNEN, Rome). Boll. Zool., 29: 763-74(1962). (RT/B10(64)4). (In Italian)

Terminal plates from 12 and 13 days old albino Swiss mouse embryos were irradiated with 185 to 925 r of gamma rays, and then cultivated in vitro for time intervals ranging from one hour to four days. Limb buds from 12 and 13 days old embryos developed and differentiated during the cultivation in vitro. Within the digital precartilagineous condensations, which were already present at the time of explantation, cartilagineous matrix appeared or increased, and gradually spreads to the whole precartilagineous blastema. All the skeletal cartilagineous elements of the autopodium with the interposed articular interzones, are clearly seen after four days of culture. The undifferentiated mesenchyme, situated in the interdigital spaces, had a much greater sensitivity to radiation than the cartilage. Ten to twelve hours after irradiation with 330 r the frequency of degenerated cells was about 40% in the mesenchyme and only about 1% in the cartilage. The comparison between the frequency of degenerated cells and the changes in the mitotic index during a 36 hour period after irradiation with 330 r, indicates that cellular death in both tissues was not probably correlated with the mitotic activity. In limb buds explanted at 12 days and irradiated with 925 r it was observed that, in about one half of the cultures the cartilage showed an increased amount of matrix with respect to the control. Such feature is accompanied after 3 and 4 days of culture by some changes in the cell shape, which resemble the morphology of columnar cartilage. (auth)

31154 MITOTIC ACTIVITY OF THE TRACHEO-BRONCHIAL TREE OF THE EMBRYONIC LUNG OF MICE EXPOSED TO GAMMA RAYS AND CULTIVATED IN VITRO. Susetta Pons and Ettore Rotondi (CNEN, Rome). Boll. Zool., 29: 775-85(1962). (RT/BI0(64)3). (In Italian)

Lung rudiments of albino Swiss mice embryos were explanted at the 11th day of gestation and exposed to 830 r x radiation from a ^{60}Co source and then cultivated in vitro by the hanging-drop method for time intervals ranging from one to 24 hr. The mitotic index in the tracheal and bronchial epithelium decreased rapidly to zero one hour after irradiation, and remained very low until the fifth hour and then rose above the control values. The mitotic delay lasted about four hours and was caused by blockage in the progression of mitosis occurring probably during late prophase. The number of surviving cells in the tracheal and bronchial epithelium decreased rapidly during the first four hours post-irradiation to about 50% of the control, where it remained unchanged. It was concluded that, in the tissue studied, the cellular death by gamma radiation is independent of the mitotic activity, as cellular degeneration occurred in a time interval during which mitosis was blocked. (C.H.)

31155 INFLUENCE OF X IRRADIATION AND RESTORATION BY ISOLOGOUS CELLS OF DIFFERENT ORIGIN ON THE IMMUNITY INDUCED AGAINST EHRLICH TUMOR. C. Mazurek and J. F. Duplan (Institut du Radium, Paris). Bull. Assoc. Franc. Etude Cancer, 50: 19-28(1963). (In French)

A study was made of the effects of x rays, followed by isologous transplantation by cells from the spleen, bone marrow, or fetal liver, on the immunity developed against subcutaneously grafted Ehrlich tumor. Mice 90 to 100 days old were subjected to a total dose of 750 r. From one to three hr postirradiation they received an intravenous injection of isologous hemopoietic cells. Four aspects were studied: the percentage of tumor growth in irradiated and restored mice; the persistence of the immunity established prior to irradiation; the effect of irradiation followed by one of the various types of grafting previously mentioned on capacity of the mice to be immunized against Ehrlich tumor; and the possibility of enhancement of the acquired immunity established prior to irradiation by the transferred immunity obtained by injection of restorative cells from immune donors. Results showed that the percentage of tumor growth decreased in nonimmunized mice irradiated at least 30 days before grafting. Immunization prior to irradiation did not have a favorable effect on the rejection of grafts performed 30, 45, or 60 days following exposure to x rays. It seems that immunologic memory is partial or nonexistent following a dose of 750 r, whatever type of transplanted cell is used. Fetal liver cells proved to be inadequate immunologically. The combination of immunization prior to irradiation with restoration by immune donor spleen cells produced a passively acquired immunity lasting 45 or more days, in which actively acquired host immunity played no part. X-ray exposure was responsible for increasing duration of immunity, which was greater than usual in this type of passive immunity. (BBB)

31156 PROBLEMS IN DOSIMETRY POSED BY EXPERIMENTAL ANIMALS. Gérard Legeay. Bull. Inform. Sci. Tech. (Paris), No. 82, 63-5(Apr. 1964). (In French)

31157 CHANGES IN THE CONTENT OF SOME AMINO ACIDS IN THE BLOOD AND URINE FOLLOWING EXPOSURE TO LOW TEMPERATURE AND IONIZING RADIATION. Yu. K. Ledentsov. Byul. Eksperim. Biol. i Med., 56: No. 8, 60-4(1963). (In Russian)

An inquiry was made into the content of free amino acids in the blood and urine of rats during the action of low temperature, ionizing radiation, and their combination. The blood and urinary content of free amino acids differed at various periods of radiation sickness. At the height of radiation sickness there was a rise in the blood of all the amino acids without marked aminaciduria, excluding alanine; in the action of low temperature a distinct rise of urinary amino acid excretion was noted. In combined action of low temperature and irradiation there was a rise of blood content of all the amino acids. In the urine of this series of animals the amount of alanine increased, whereas the content of leucine dropped. (auth)

31158 NON-RANDOMNESS IN THE RECOVERY OF DETACHMENTS FROM THE REVERSED METACENTRIC COMPOUND X CHROMOSOME IN DROSOPHILA MELANOGASTER. George E. Brosseau, Jr. (Univ. of Iowa, Iowa City). Can. J. Genet. Cytol., 6: 201-6(June 1964).

Non-random recovery of x-ray-induced reciprocal detachment products from a reversed metacentric compound-X chromosome (attached-X) was investigated. The study was restricted to detachments resulting from exchange with the Y chromosome, the use of a doubly marked Y (B^sYy^+) permitting ready identification of all the detachments. The distribution of the exchange points along the Y chromosome was determined by the use of the fertility genes as markers. The findings support the hypothesis that non-random disjunction favors the recovery of some detachment products over others. Thus asymmetrical dyads must be present at the second meiotic division and therefore the exchange yielding detachments must occur between chromatids at the four strand stage. About 70% of the detachments had the break in B^sYy^+ located in a region which is homologous to a portion of the X suggesting that these regions were synapsed at the time of exchange. These results suggest that a significant fraction of x-ray-induced detachments

may represent induced crossing over in heterochromatin rather than translocation. (auth)

31159 METHODS FOR ANEUPLOID PRODUCTION IN COMMON OATS, AVENA SATIVA. Tibor Rajhathy and P. L. Dyck (Canada Dept. of Agriculture, Ottawa). Can. J. Genet. Cytol., 6: 215-20(June 1964).

Four methods of producing oat aneuploids were compared. No haploids were found for use in aneuploid production. Advanced derivatives of backcrossed pentaploid hybrids yield a high frequency of aneuploids, but their heterogeneity and heterozygosity make their use impractical. Varietal populations have a low yield of aneuploids, but those obtained are homozygous. The use of irradiated populations, screened for pollen and seed sterility before cytological selection, appears to be the most efficient method because of very high aneuploid yield combined with homozygosity. (auth)

31160 IMPROVEMENT OF FLUE-CURED TOBACCO BY MEANS OF IONISING RADIATION. G. S. Murty and K. V. Krishnamurthy (Central Tobacco Research Inst., Rajahmundry, India). Euphytica, 12: 285-93(1963).

Three commercial varieties of flue-cured tobacco, Chatham, Delcrest, and Hicks, were subjected to neutron irradiation using six different doses ranging from 1×10^{12} to 5×10^{13} N/cm^2/sec. The N_1 generation was grown in the field during 1959–60. Only plants from the lowest two doses, 1×10^{12} and 2.5×10^{12} N/cm^2/sec, survived in the field up to the adult stage. From this material, normal plants with high pollen fertility were selected for testing their performance in replicated trials. The progenies of the selected plants were raised in the field during 1960–61. The data collected showed that although there were no significant differences in the means in some characters there was a significant shift in the variance among treated plants as compared to the control. Advantage was taken of this greater variance among the treated progenies and selections were made for certain specific characters, such as narrow leaf and long internodes in Chatham, broader leaf, late flowering, and greater leaf number in Delcrest and Hicks. A new leaf mutant in the variety Delcrest was isolated and found to be agronomically superior to the untreated control. This mutant is characterized by hooding of the leaf tip and is designated leaf tip hooded. Replicated trials were conducted for the narrow leaf and long internoded types in Chatham, the leaf tip hooded in Delcrest and the late flowering selections in Hicks, during 1962–63. The narrow leaf selection in Chatham bred true. The long internode type was found to be segregating. The leaf tip hooded mutant in Delcrest was found to breed true and has also maintained its superior performance. The achievements and scope of the mutation breeding program in flue-cured tobacco are broadly discussed. (auth)

31161 THE EFFECT OF P^{32} ON THE EARLY DEVELOPMENTAL PHASES OF TRITURUS VULGARIS EGGS. T. Holan, A. Rosenberg, I. G. Russu, L. Diacu, and A. Bozac. Fiziol. Normala Pathol. (Bucharest), 9: 169-73(1963). (In Rumanian)

A study of nucleic acid alterations in triton eggs exposed to different ^{32}P doses for various periods of time showed that the effect of ionizing radiations is stronger with low isotope concentrations and longer exposure than with high concentrations and shorter exposure periods. The most pronounced alterations were noted at the RNA level. (auth)

31162 HISTOCHEMICAL STUDIES ON ACTIVITY AND DISTRIBUTION OF ACID PHOSPHATASE, NON-SPECIFIC ESTERASE, AND E 600-RESISTANT ESTERASE IN JEJUNAL MUCOSA DURING ACUTE RADIATION DISEASE. Jan Jonek, Stanisław Kośmider, and Józef Kaiser (Silesian Medical School, Zabrze, Poland). Intern. J. Radiation Biol., 7: 411-19(Nov. 1963).

Histochemical studies on activity and localization of some enzymes (acid phosphatase, non-specific esterase, E 600-resistant esterase) in the jejunal mucosa of guinea pigs were performed at certain stages of radiation disease induced by x rays. Results obtained revealed a positive correlation between acid-phosphatase activity and advances of disease. The activity increase of this enzyme in the mucosal cells signifies intensifying catabolic processes. After irradiation, changes of thiolacetic esterase activity were observed which seem to be related to the stages of radiation and which may implicate fatty acid metabolism. Reaction to E 600-resistant esterases increased linearly to time after irradiation, indicating catabolic activation in the intestinal mucosa. (auth)

31163 EFFECT OF LOW TEMPERATURE ON RADIOSENSITIVITY OF DROSOPHILA PUPAE. S. Giavelli and E. Parazzi (Universita, Milan). Intern. J. Radiation Biol., 7: 465-71(Nov. 1963).

To study the differential radiosensitivity of male germ cells and whether this is due to different metabolic conditions of the flies, 24- and 48-hr-old pupae of Drosophila melanogaster were irradiated with 220 kv x rays with a dose of 600 r at 0° and 25°C. Soon after emergence each male was mated to three M-5 virgin females, then transferred into a new vial with three virgin females every day for ten days, to permit study of the radiation damage induced in germ cells irradiated at different periods of gametogenesis. The number of progeny of these matings and the recessive sex-linked lethal mutations were scored. A lower number of progeny was found in the broods of the experiments at 0 than at 25°C. No difference was observed in the mutation frequency induced by the treatments of 24- and 48-hr-old pupae. With low temperature no difference appeared in the sensitivity pattern of pupae of different age. No evidence was found that different physiological conditions of pupae at different age may determine a different radiosensitivity. The effect of low-temperature treatment is discussed. (auth)

31164 EFFECTS OF GAMMA RADIATION ON THE FERTILITY OF THE COMMON CATTLE GRUB, HYPODERMA LINEATUM (DE VILLERS). R. O. Drummond (Dept. of Agriculture, Kerrville, Tex.). Intern. J. Radiation Biol., 7: 491-5(Nov. 1963).

At 9 to 13 days after collection from the backs of cattle as larvae, or 6 to 8 days before heel flies emerged, pupae of the common cattle grub, Hypoderma lineatum (de Villers), were exposed to 1000, 2500, 5000, or 7500 r of γ radiation from a ^{60}Co source. Flies from irradiated pupae were mated with those from nonirradiated pupae to determine fertility of the treated individuals. At 5000 and 7500 r both sexes were completely sterilized; at 2500 r females were completely sterilized and males exhibited reduced fertility. (auth)

31165 THE EFFECTS OF WATER AND A PROTECTIVE AGENT ON GAMMA-RAY INDUCED FREE RADICALS IN MUSTARD SEEDS. R. F. Cook (Royal Military Coll. of Science, Swindon, Eng.). Intern. J. Radiation Biol., 7: 497-504(Nov. 1963).

Electron-spin-resonance experiments on irradiated seeds showed that the radicals induced by γ radiation are very sensitive to the moisture content of the seeds. However, at x-band frequencies the dielectric effect of the water in

the sample has limited such experiments to moisture contents of about 12%. By using an E.S.R. spectrometer of low microwave frequency the γ-induced radicals in white mustard seeds were studied with moisture contents of up to 70% by weight, and measurements made while γ irradiation was in progress. Both radical production and radical decay were studied in seed samples of various moisture contents and in seeds treated with the protective agent AET. (auth)

31166 ROLE OF ADRENALS IN INCREASING THE RADIOSENSITIVITY OF RATS IRRADIATED IN O_2 ATMOSPHERE. A. Vacek and E. Davidova (Inst. of Biophysics, Brno). Intern. J. Radiation Biol., 7: 509-10(Nov. 1963).

Adrenalectomized rats irradiated in O_2 with cortisone treatment survived longer than untreated controls. It was concluded that the radiosensitivity of mammals is closely connected with the state of their humoral system and the functioning of regulatory mechanisms. (C.H.)

31167 INFLUENCE OF PRELIMINARY IRRADIATION ON THE RADIORESISTANCE OF RATS. S. P. Vlasenko and E. L. Shakhnazaryan (Radiology Sector, Academy of Medical Sciences, USSR). Izv. Akad. Arm. SSR, Biol. Nauki, 17: No. 1, 37-40(Jan. 1964).

Changes in the radiosensitivity of irradiated rats were found to depend on the length of the interval between the preliminary and the second irradiation. A protective effect was shown to exist only after an interval of 14 days. It was difficult to link the protective effect of preliminary irradiation with any specific system or organ. The influence of preliminary irradiation on the gas exchange of the animals when they are irradiated for the second time is discussed. It was concluded that, providing there is a 14-day interval between the two irradiations, the preliminary irradiation helps to normalize the gas exchange when the second irradiation takes place, and thus helps to prolong the life of the irradiated animals. (OTS)

31168 THE BEHAVIOR OF RADIOACTIVE SULFUR IN CHRONIC EXPERIMENT. N. M. Oganesyan (Inst. of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR and Inst. of Physiology, Academy of Sciences, Armenian SSR). Izv. Akad. Arm. SSR, Biol. Nauki, 17: No. 1, 41-5(Jan. 1964).

The distribution of ^{35}S in mammals was studied. It was concluded that when the isotope ^{35}S is chronically present, it is distributed essentially evenly in all the organs and tissues, as is the case when it has momentarily penetrated into the organism. There are, however, small differences: in the case of its momentary penetration, slightly larger amounts can be found in the gastrointestinal tract, the kidneys, the liver, and slightly lesser amounts in the blood, the testicles, the spleen, the brain, the lungs, and the skin. If ^{35}S is chronically present, a slightly higher level of activity can be detected in the gastrointestinal tract, the kidneys, the spleen, the bones, and a slightly lesser level in the skin, the testicles, the liver, the lungs, the muscles, the brain, and the blood. The processes of elimination of ^{35}S were also studied. Whether it was chronically or momentarily present in the organism, ^{35}S was mostly eliminated through urine (51.5 ± 5.2%), and much less through feces (16,5 ± 1.2%). (OTS)

31169 EFFECTS OF IONIZING RADIATION ON THE GROWTH AND HARVEST OF ALFALFA. F. G. Isaeva. Izv. Akad. Nauk Azerb. SSR, Ser. Biol. i Med. Nauk, No. 1, 67-74(1963). (In Russian)

Alfalfa seeds were given ^{137}Cs γ doses ranging from 250 to 10,000 r. Ascorbic acid, stem and leaf weights, and seed yields were determined at various time intervals following irradiation. Seed yields and ascorbic acid contents increased continuously with dose up to 5000 r and 2500 r respectively. In field tests plant heights and root lengths were somewhat greater in treated plants and seed yields were increased from 3 to 10% independently of radiation dose. Seeds soaked in various concentrations of ^{32}P prior to field tests produced yield increases of 1 to 13%. (H.M.G.)

31170 THE EFFECT OF IONIZING RADIATION AND CHEMICAL COMPOUNDS ON GROWTH PROCESSES AND INHERITED VARIABILITY IN THE POTATO. N. D. Tarasenko (Inst. of Cytology and Genetics, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Biol-Med. Nauk, 1: 35-40(1963). (In Russian)

In potato tubers irradiated with x rays, γ rays, or fast neutrons, growth was generally retarded or inhibited, the most marked effect being from irradiation. Ethylenimine applied to eyes with 1 to 2 mm sprouts resulted in retarded growth, but equivalent or enhanced tuber yield. When ethylmethylsulfonate was applied to the eyes, both growth and tuber yield were adversely affected. Chemicals and irradiation increased the frequency of chromosomal aberration in the anaphase and telophase of mitosis. While radiation effects on chromosomes were characterized by chromosomal bridging, chemical treatment resulted in bridging and fragmentation. (H.M.G.)

31171 HARMFUL EFFECTS OF ^{90}Sr ON WHEAT. E. V. Yudintseva. Izv. Timiryazev. Sel'shokhoz. Akad., No. 3, 94-101(1963). (In Russian)

Deleterious effects of ^{90}Sr on wheat were studied in water cultures to which 2.0 to 3.3 mc/5.51 ^{90}Sr concentrations were added. Generative organs were affected most, spikes grown in 3.3 mc concentrations being completely sterile. Mineral nutrition was not affected, but nitrogen and carbohydrate metabolism disruption were evident. Metabolic effects were considered as resultant of generative organ damage. (H.M.G.)

31172 DOSE-MUTATION RELATIONSHIPS IN ULTRAVIOLET-INDUCED REVERSION FROM AUXOTROPHY IN ESCHERICHIA COLI. Ruth F. Hill (Columbia Univ., New York). J. Gen. Microbiol., 30: 281-7(1963).

Curves for the absolute yield of revertants as a function of ultraviolet (uv) radiation dose were obtained after post-irradiation incubation in saline and after exposure to reactivating light. The curves exhibited plateau regions and final slopes which were equal to the slopes of the survival curves for the auxotrophic Escherichia coli parent. These features may be due to a saturation of the mutagenic effect at low doses. This saturation would be the result of heterogeneity in the unirradiated population with respect to the amount of protein and RNA synthesis which can occur before DNA replicates in the irradiated organisms, combined with limitation of the observable yield by the selection method. The observable yield would be derived from the fraction of the population most resistant to the lethal effect of radiation. (auth)

31173 THE STABILITY OF SPONTANEOUS AND ULTRAVIOLET-INDUCED REVERSIONS FROM AUXOTROPHY IN ESCHERICHIA COLI. Ruth F. Hill (Columbia Univ., New York). J. Gen. Microbiol., 30: 289-97(1963).

Spontaneous and uv-induced revertants were found to be unstable in serial subculture. Instability was manifested by replacement of the original revertant by revertants with slower growth rates on minimal medium, and the appear-

ance of auxotrophic organisms which overgrow in some cases but not others. In one case, the instability was found to be more pronounced when the organisms were maintained in the logarithmic phase of growth. This evidence, along with the previous radiological evidence, was interpreted according to the following hypothesis. The auxotrophic organism has an episomic element located at the suppressor locus. The damage inflicted by radiation consists in the detachment of this episome. The prototrophic cell may again become auxotrophic by reattachment. (auth)

31174 A REVIEW OF SOME RECENT FINDINGS ON RADIATION-INDUCED TANNING OF MAMMALIAN SKIN. Walter C. Quevedo, Jr. (Brown Univ., Providence). J. Soc. Cosmetic Chemists, 14: 609-17(Dec. 1963).

Results are reported from a series of studies on the nature of ultraviolet damage to the epidermis of mice. It is pointed out that when mammals are exposed to uv, the epidermis of their skin becomes darker, or tanned, and thicker. The influence of hormones, genetic factors, and species differences on the mechanics of pigment control are discussed. (C.H.)

31175 FAILURE OF QUINOXALINE-1,4-DI-N-OXIDE TO INCREASE THE SURVIVAL TIME IN IRRADIATED DOGS INFUSED WITH AUTOLOGOUS MARROW. William E. Trumbull, Iwao G. Kawakami, Jack A. Cannon and Thomas J. Haley (Univ. of California, Los Angeles). J. Surg. Res., 4: 103-5(Mar. 1964).

Quinoxaline-1,4-di-N-oxide administered in divided doses to a total of 200 mg/kg prior to irradiation stimulated leukopoiesis in autografted dogs, thus making their bone marrow more susceptible to the damaging effects of x irradiation. The end result was a decrease in both mean survival time and total survival as compared to control dogs receiving the autograft alone. (auth)

31176 FROZEN-IRRADIATED HOMOGRAFTS SHIELDED WITH MICROFILTER SHEATHS IN PERIPHERAL NERVE SURGERY. James B. Campbell, C. Andrew L. Bassett, and Joerg Boehler (New York Univ., New York). J. Trauma, 3: 303-11(July 1963).

The technique and clinical experience with frozen nerve homografts sterilized by a Van de Graaff generator are described. The stumps of the nerve and graft are prepared before suturing a frozen-irradiated homograft of appropriate length and caliber into the gap. Grafts were procured from cadavers, sterilized, and preserved by techniques used in banking bone. Twenty-four patients were treated with grafts to span irreducible gaps ranging in length from 2.5 to 13.5 cm in the following nerves: recurrent laryngeal, ulnar, median, radial, peroneal, and femoral. The most outstanding success was the return of autonomic, sensory, and motor function one yr after bridging an 8.5-cm gap in the ulnar nerve. The study showed that bone sterilized by irradiation and preserved by freezing was a suitable mechanical substitute for autogenous bone in reconstructive surgery. In an experimental study, the cellular reaction of similarly treated feline nerves was compared with autografts and fresh homografts as well as aseptically procured freeze-dried and fresh-frozen material. Results obtained with treated homografts of these three types were excellent from the point of view of return of function. Comparison of the cellular response, evoked by fresh homografts, frozen homografts, and frozen-irradiated homografts two weeks after implantation, showed that the reaction with the first was violent, the second moderate, and the third minimal to the point of being difficult to detect. The dose of radiation delivered to the grafts appears to reduce the tissue reaction evoked by an unshielded homograft to a negligible level. (BBB)

31177 SAMPLING WHITE-TAILED DEER ANTLERS FOR STRONTIUM-90. Vincent Schultz (Atomic Energy Commission, Washington, D. C.). J. Wildlife Management, 28: 45-9(Jan. 1964).

The ^{90}Sr and calcium content of five portions of the left antler of four white-tailed deer (Odocoileus virginianus) was determined. There were no statistically significant differences among position averages for $\mu\mu c$ of ^{90}Sr per gram of ash, $\mu\mu c$ of ^{90}Sr per gram of calcium, and percent calcium per gram of ash. A 1-degree-of-freedom comparison of main beam versus point samples resulted in significant F-values. As a result of the relatively large variability among deer, other sources of variability inherent in field problems, and the relatively small difference among position averages, it is concluded that the segment of the antler sampled for ^{90}Sr is of no great consequence in many studies of ^{90}Sr accumulation in white-tailed deer antlers. (auth)

31178 EFFECT OF γ-RAYS ON THE SYNTHESIS OF CAROTENOIDS IN TOMATOES. L. P. Koval'skaya and K. V. Vasil'eva. Konserun. i Ovoshchesushil'n. Prom., 18: No. 7, 29-32(1963). (In Russian)

The effect of ionizing radiation on formation of carotene and lycopene as the coloring matter in tomatoes was studied. The plant in its various development stages in which the process of synthesis of carotenoids differed was subjected to γ-rays from ^{60}Co at 24 and 1100 r/sec. The results showed that by treating tomato plants with ionizing radiation, the carotenoids are not destroyed; however, the formation of pigments is inhibited. The magnitude of the γ-rays has a definite effect in that the higher it is the lower is the concentration of coloring matter in tomatoes. This is true in every development stage of the plant. (H.M.G.)

31179 NORMAL PLASMA IRON CLEARANCE TIME IN SHEEP AND THE SIGNIFICANCE OF CHANGES FOLLOWING EXPOSURE TO IONIZING RADIATION. Merton A. Quaife and Lawrence T. Odland (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Laval Med., 34: 1238-41(Dec. 1963).

The normal plasma Fe clearance half time in Ovis aries was determined to be 146 min with standard deviation of ± 27.5 min and a standard error of the mean of 2.5 on the basis of 118 determinations. Plasma Fe clearance rates were markedly decreased as early as the second day following exposure to neutrons and x rays, and remained so for the subsequent seven days. Animals destined to survive the radiation insult demonstrated near normal clearance rates by the 16th day post exposure. The use of this parameter as a predictor of recovery from radiation injury is suggested. (C.H.)

31180 THE INFLUENCE OF RADIUM THERAPY OF ESOPHAGEAL CANCER ON THE COURSE OF PULMONARY TUBERCULOSIS. T. A. Tretyakova (Central Inst. for Graduate Work in Medicine, Academy of Sciences, USSR). Med. Radiol., 9: No. 4, 17-21(Apr. 1964). (In Russian)

Studies were made on the course of pulmonary tuberculosis in patients subject to radium therapy for cancer of the esophagus. In 20 patients out of 270 with esophageal cancer tuberculosis was a concomitant disease. The patients underwent a course of x-ray therapy or were irradiated on a gamma-therapy unit (^{137}Cs). Exacerbation of the tuberculous process occurred in 6 patients, in most of the latter it was not marked and was amenable to specific antibacterial treatment. Progression of the tuberculous process

depends primarily upon its form and stage prior to irradiation, and not on the type of ionizing radiation or its dose. In disseminated and active tuberculous changes in the lungs, radium therapy should be instituted against the background of antibacterial treatment. (auth)

31181 REACTION OF THE SPLEEN, LYMPH NODES AND LOOSE CONNECTIVE TISSUE TO ANTIGENIC STIMULI IN IRRADIATED ANIMALS. V. V. Shikhodyrov and N. N. Klemparskaya. Med. Radiol., 9: No. 5, 29-34 (May 1964). (In Russian)

Morphological changes occurring during radiation sickness in immunized animals are discussed. Experiments were examined on albino mice. The animals were vaccinated with a warmed vaccine of Bacillus breslau culture. The irradiation (500 r) was performed on the RUM-3 apparatus. The results derived show the reaction of the spleen, lymph nodes and loose connective tissue occurring during the development of immunity. In immunized and then irradiated animals the changes in the internal organs, responsible for the production of immune bodies, were not as pronounced as in the irradiated animals. A supposition is set forth that an increased resistance of immunized animals depended on changes occurring in the internal tissues of the organism. (auth)

31182 TRANSAMINASE ACTIVITY OF THE BLOOD AS AN INDEX OF LIVER AFFECTION IN ACUTE RADIATION SICKNESS. L. L. Fedorovskii. Med. Radiol., 9: No. 5, 35-9(May 1964). (In Russian)

The content of transaminases, cholinesterase and bilirubin was investigated in the blood of dogs and rats with acute radiation sickness. It was established that the content of glutamicopyruvic transaminase (GPT) manifested the earliest and most distinct change. Experiments on angiostomized dogs enabled to disclose the fact that the level of transaminases (especially of GPT) in the blood outflowing from the liver is higher than that in other vessels, this testifying to affection of the liver. (auth)

31183 REMOTE IMMUNOLOGICAL SEQUELAE OF THE ACTION OF IONIZING RADIATION ON THE ORGANISM. P. N. Kiselev and P. A. Buzini. Med. Radiol., 9: No. 5, 50-8(May 1964). (In Russian)

The state of natural immunity and the process of immunogenesis, as well as the susceptibility to infection in animals 3 to 28 months after acute radiation sickness were investigated. The experiments were staged on albino mice irradiated in a dose of 465 to 500 r and on guinea pigs subjected to 200 r. In animals which sustained acute radiation sickness, an elevated sensitivity to pathogenic and conditional-pathogenic microörganisms is preserved for a prolonged time. The augmented susceptibility of previously irradiated animals is the result of prolonged decrease of the general resistance of the organism, associated with weakening of the antimicrobial and antitoxic functions of the organism. In this respect disturbance of the cellular immunity is of major importance. At this time, humoral factors of immunity are, as a rule, unchanged. (auth)

31184 RELATIVE BIOLOGICAL EFFECTIVENESS OF IONIZING RADIATIONS. L. De Marco (Università, Ferrara, Italy). Minerva Fisioterap., 5: 107-14(May-June 1960). (In Italian)

Units of measurement used in comparisons of the relative biological effectiveness of ionizing radiations are discussed. The physical and medical meanings of relative biological effectiveness and of linear energy transfer are reviewed and their probable reciprocal dependence illustrated by results of measurements. Emphasis is placed on high voltage x rays, x rays, neutrons, and α particles. (55 references.) (C.H.)

31185 THE EFFECTS OF RADIATIONS ON NUCLEIC ACIDS. Giovanni Giannoni. Minerva Med., 53: 697-9 (Mar. 7, 1962). (In Italian)

Some possible mechanisms whereby ionizing radiations produce changes in and cause degradation of RNA and DNA are discussed, with particular reference to preliminary experiments in which fractions of irradiated DNA are separated on ion-exchange resins. (BBB)

31186 STUDIES ON THE BIOLOGICAL INFLUENCE ON THE TERMITES EXPOSED TO Co^{60} GAMMA SOURCE. I. INFLUENCES ON THE ADULT OF FORMOSAN TERMITE AND ITS OFFSPRING. Shigeru Nakajima, Kaoru Shimizu, and Yoshito Nakajima (Univ. of Miyazaki, Japan). Miyazaki Daigaku Nogakubu, Kenkyu, Jiho, 8: 340-6(Mar. 1963). (In Japanese)

Termites of both sexes were exposed to ^{60}Co x radiation doses ranging from 3,000 to 12,000 r before mating with irradiated and non-irradiated partners. The longevity and fecundity of the termites were reduced in proportion with the increase in dose from 3,000 to 12,000 r, and the number of the soldier caste emerging was also decreased with the increase in radiation dose. (C.H.)

31187 EFFECT OF GAMMA RAYS ON L-ASCORBIC ACID. M. Tomaňa, O. Švábenský, and K. Otta. (Zentralforschungsinstitut für Lebensmittelindustrie, Prague). Nahrung, 7: 212-21(1963). (In Germany)

The effects of ionizing radiation on the oxidation of L-ascorbic acid in model solutions and fruits were observed. It was ascertained, that the course of the oxidation of L-ascorbic acid is, within the range of observed concentrations and doses, linear. The rate of oxidation is inversely proportional to the concentration of the L-ascorbic acid and to the intensity of radiation. A similar relationship for the destruction of dehydroascorbic acid was found, however the rate of reaction is slower in this case. The rate of oxidation of L-ascorbic acid is furthermore increased by a decrease of the pH, presence of oxygen and ions of heavy metals. Protective effects for the L-ascorbic acid were shown by nicotinic acid and the enzyme catalase. The final retention of L-ascorbic acid at prolonged keeping qualities of the fresh fruits by ionizing radiations is favorable. (auth)

31188 THE STRONTIUM-90 ACTIVITY OF MILK AS COMPARED TO FALL-OUT BETA ACTIVITY AND AMOUNT OF RAINFALL IN THE TIME PERIOD OCTOBER 1961 TO DECEMBER 1962. H. Seidler and G. Eschenbach (Institut für Ernahrung, Potsdam, Ger. and Deutsche Akademie der Wissenschaften, Berlin). Nahrung, 7: 588-90(1963). (In German)

The quantity of the atmospheric precipitations, the beta-fallout-activity, and the ^{90}Sr-activity of the milk, during the time from October 1961 until December 1962, in the district of Potsdam are reported. An explanation for the relations between these three values is given. (auth)

31189 COMPARATIVE ASPECTS OF CARCINOGENESIS BY IONIZING RADIATION. Arthur C. Upton (Oak Ridge National Lab., Tenn.). Natl. Cancer Inst. Monograph, No. 14, 221-42([1963]).

Ionizing radiations appear carcinogenic to all mammalian species studied thus far. Species vary widely, however, in the probability of induced neoplasms of any given organ and cell type, and within a species there are variations in susceptibility according to strain, sex, age at irradiation,

physiologic condition, and other factors. The relation between radiation dose and probability of neoplasia is complex but suggests, in general, that the neoplastic transformation involves a multistage process rather than a single, one-hit type of alteration. Radiation of low linear energy transfer (LET) is generally more effective when administered at a high intensity than at a low intensity; high-LET radiation is, in general, relatively less dose-rate-dependent and more effective than low-LET radiation. Many of the carcinogenic effects of radiation are reproduced by radiomimetic chemicals, especially those known to have mutagenic and chromosome-breaking potency; however, the combined effects of radiation and chemicals are not necessarily additive, which suggests that the agents may differ in mode of action. The evolution of neoplasia, furthermore, appears in many instances to require interaction of cancer-forming cells with extrinsic cancer-promoting factors in their environment, and in some cases the cancer-forming cells themselves need not be irradiated. Hence, the significance of mutagenic effects in carcinogenesis is not clear. In the pathogenesis of certain radiation-induced neoplasms, oncogenic viruses appear to be involved, the origin and role of which remain to be defined. (auth)

31190 INCORPORATION OF 5-IODO-2′-DEOXYURIDINE INTO BACTERIOPHAGE T1 AS RELATED TO ULTRA-VIOLET SENSITIZATION OR PROTECTION. W. Dean Rupp and William H. Prusoff (Yale Univ., New Haven). Nature, 202: 1288-90(June 27, 1964).

Experiments are described on the survival after ultraviolet irradiation of normal and 5-iodo-2′-deoxyuridine (IUdR)-containing bacteriophage when irradiated with and without cysteamine and plated on the uvr^+ and uvr^- strains of Escherichia coli K-12. The survival of phage that contained IUdR is lower than that of unsubstituted control phage, a finding that is in agreement with the sensitization produced by halogenated pyrimidine in other systems. Whereas the presence of cysteamine had virtually no effect on the ultraviolet sensitivity of normal unsubstituted phage, it eliminated the increased sensitivity observed in the IUdR-substituted T1 phage. When uv-irradiated phage was assayed on E. coli, the survival of control and irradiated phage was much lower when plated on uvr^- than uvr^+. Survival of control phage was not affected by the presence of cysteamine during irradiation. IUdR-labeled phage showed higher survival when irradiated in the presence of cysteamine especially when plated on E. coli uvr^-. Experimental IUdR-labeled T1 phage contained about 40% of the normal complement of thymine. It was concluded that incorporation of IUdR into bacteriophage may result in either radiation-sensitization or protection. (H.M.G.)

31191 A NEW HETEROLOGOUS RADIATION CHIMERA. D. W. van Bekkum (Organization for Health Research TNO, Rijswijk, Netherlands). Nature, 202: 1311-12(June 27, 1964).

Bone marrow from Mesocricetus auratus (hamsters) was injected into the tail vein of x irradiated CBA mice. Recipients were kept on a commercial diet supplemented with penicillin or streptomycin for 30 days after injection. Antibiotic administration thereafter was intermittent. Techniques used to demonstrate the presence of cells derived from the hamster hematopoietic transplant were: alkaline phosphatase identification of hamster polymorphonuclear granulocytes; erythrocyte typing by agglutination tests with specific anti-hamster and anti-mouse sera; differences in chromosomal number as shown by mouse and hamster bone marrow cells. Survival of hamster skin grafts were also studied in mice. (H.M.G.)

31192 INFLUENCE OF VARIOUS SUBSTANCES ON PRODUCTION OF ASCITES TUMOUR. D. N. Wheatley (Royal Cancer Hospital, London). Nature, 202: 1348-9 (June 27, 1964).

The effects of pharmacological and other treatments on ascites tumor production was studied in BALB/c female mice 14 weeks of age. Prior to tumor injection, mice were given 300 r whole-body irradiation, hydrocordisone sodium succinate, Kieselguhr (diatomaceous earth), or pitressin. Other groups received chlorothiazide, histamine dichloride, or heparin after injection. Ehrlichs' ascites tumor cells (10×10^6) were injected into all animals, and biopsies were performed on the 7th day post irradiation. The mice were measured for: total ascites production, fluid volume, and cell volume. Results show that a dose relation exists between tumor cell proliferation and fluid effusion. (H.M.G.)

31193 BREATHING DEPRESSION AFTER CHRONIC γ IRRADIATION AND PHOTOREACTIVATION IN CHLORELLA. F. Koessler (Deutsches Zentralinstitut für Arbeitsmedizin, Berlin and Deutsche Akademie der Wissenschaften, Berlin). Naturwissenschaften, 51: 289 (1964). (In German)

The CO_2 gaseous metabolism of a strain of Chlorella pyrenoidosa was studied under different irradiation conditions. Without irradiation breathing and photosynthesis was constant for 10 days. In tests with ^{60}Co after exposure for several hours to 100,000 r the CO_2 release increased as a result of increased endogenic breathing. Higher doses increased this effect. A breathing depression appeared neither after smaller nor higher doses. Under chronic irradiation with ^{192}Ir and ^{137}Cs the endogenic breathing began to decrease and in 5 to 6 days amounted to a third of the initial value. Further irradiation in the next 2 days did not change this value. The irradiations had little, if any, effect on photosynthesis. (M.C.G.)

31194 ON THE EXPLANATION OF THE BEHAVIOR OF RADIATION SENSITIVITY IN FRACTIONATED IRRADIATION. Juergen Kiefer (Universität, Gissen, Ger.). Naturwissenschaften, 51: 289-90(1964). (In German)

The effects of a "conditioning dose" of radiation on the sensitivity of cells to a second irradiation are discussed. It was assumed that each cell, whose DNA is damaged by irradiation, appears again in a synthesis phase (s-phase), in which the damage is repaired. The dependence of sensitivity on generation stage is shown. (M.C.G.)

31195 THE EFFECTS OF A WHOLE-BODY IRRADIATION OF MICE ON THE ACTIVITY OF THE DECARBOXYLASE OF AROMATIC AMINO ACIDS IN LIVER AND SPLEEN. H. Langendorff, G. Scheuerbrandt, C. Streffer, and H. J.-Melching (Universität, Freiburg i. B.). Naturwissenschaften, 51: 290(1964). (In German)

White mice were irradiated with a whole-body dose of 690 r and the activity of amino acid decarboxylase with o-tyrosin as substrate was determined in the homogenates of spleen and liver. Results showed a significant decrease in enzymatic activity in the liver, but not in the spleen. (M.C.G.)

31196 FAST NEUTRON ABSORPTION DOSE ESTIMATED FROM THE ELEMENTAL CONSTITUTION OF BONE MARROW OF SMALL ANIMALS. Osamu Yamamoto, Shozo Sawada, et al. (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 141-5(May 1963).

Rats were used as the mammal for the experiment. The proportion of chemical elements in the bone marrow and the other soft tissues was obtained from the weight difference between wet tissue and dried tissue together with

elemental analysis of the dried tissues. From these proportions, the absorbed dose estimation for 14.1-Mev neutrons was attempted. No difference of elemental constitution or the estimated absorbed doses between the bone marrow and the other tissues could be recognized. As the decrease in absorbed dose in the bone marrow cannot be considered to be due to the smaller content of hydrogen in the bone marrow, a different approach should be considered. (auth)

31197 BONE MARROW DOSE IN FAST NEUTRON IRRADIATION CALCULATED FROM GEOMETRICAL BONE STRUCTURES. PART I. Osamu Yamamoto (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 146-56 (May 1963).

Based upon Spiers' theory, calculations of energy absorption were made for 14.1-Mev fast neutrons. The energy absorption at point P in a plane of bone marrow was calculated for the effect on the bone and the soft tissues on only the side of point P from which the neutrons entered. This was done because proton scattering takes place in front of the collision point with the neutron. The energy absorption in bone marrow was found to decrease with decrease in distance from the interface between the bone and the bone marrow on the side of the neutron source. These energy absorption curves were opposite in shape to those of x rays. The thicker the bone layer, the more conspicuous became the decrease in the energy absorption. However, some corrections were needed. (auth)

31198 14.1 MEV FAST NEUTRON EQUIVALENCE OF WHOLE-BODY X-IRRADIATION FOR THE GROWTH DELAY OF MICE. Osamu Yamamoto (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 157-62(May 1963).

Two kinds of radiations, 180-kvp x rays and 14.1-Mev neutrons, were used in this experiment. Four-week-old male mice were irradiated and the growth delay according to body weights and body weight reductions on the third day after exposure were compared. The RBE of 14.1-Mev neutron to 180 kvp x ray to bring about the same degree of growth delay and the same degree of body weight reduction on the third day after irradiation was found to be 2.21 and 1.68, respectively. (auth)

31199 ATROPHY OF SOME ORGANS OF YOUNG MICE FOLLOWING 14.1 Mev FAST NEUTRON AND X-RAY IRRADIATIONS. Osamu Yamamoto (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 163-7 (May 1963).

Young mice were exposed to 180-kvp x rays and 14.1 Mev fast neutrons. Those surviving on the 30th day after irradiation were sacrificed and their organs, that is spleen, thymus, intestine, heart, brain, liver, kidney, testicle, and seminal vesicle were weighed. Only the testicle and the seminal vesicle, the genital organs, showed an orderly and marked difference with irradiation doses. As the RBEs of 14.1-Mev neutron to 180-kvp x ray that gave 50 percent and $(e-1)/e$ growth restraint in weight, 2.66 and 2.21 for the testicle and 1.89 and 1.84 for the seminal vesicle were obtained, respectively. The extracts obtained from the testicles immersed in alcohol showed a difference in extinction values between the irradiated and the controls. The extinction value of the irradiated was higher than that of the controls. (auth)

31200 THE LOCAL BONE MARROW CHANGES FOLLOWING THERAPEUTIC TELECOBALT IRRADIATION. REPORT III. THE CHANGES OF 500 r IRRADIATED CASES. Tatsuya Kurashina (Tohoku Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1127-35(Jan. 1964). (In Japanese)

Local bone marrow changes were studied in 15 patients with malignant tumors whose sternums were irradiated with the gamma rays of a telecobalt unit. Before irradiation and 5 days after 500 r exposure to the sternal area (daily 250 r, 2 days continuously), sternal marrow aspirations and peripheral blood examinations were done. Out of 15 patients, 5 were irradiated to the axillar and supraclavicular regions in addition to the sternal area (Group B), and the other 10 were irradiated only to the sternal area (Group A). In Group A nucleated cell count was reduced to 40%, but erythrocyte count increased about 20%. Myeloblasts and proerythroblasts almost disappeared, and juvenile elements of granulocytes and nucleated red cells were markedly reduced. A decrease of matured elements, e.g., monocytes and matured granulocytes was moderate (40 to 60%), but a decrease of lymphocytes was slight (22%). Megakaryocytes were found in all cases but their morphological change was moderate and they were reduced in number. A marked reduction of mitotic figures was seen and the remnants were all myeloid. There was a slight decrease in peripheral erythrocytes but no changes were seen in peripheral leucocytes. In Group B in general, the changes of the bone marrow and the peripheral blood were similar to those of group A. Nucleated cell count was reduced to 20% and the decrease of all cell kinds was a little greater than that of group A. (auth)

31201 THE RADIATION EFFECTS ON FRIEND VIRUS DISEASE. Kiyohiko Sakamoto (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1252-64(Jan. 1964). (In Japanese)

The Friend virus disease, characterized by enlarged spleen and appearance of abnormal cells in the peripheral blood stream, is easily establishable by injecting Friend virus intraperitoneally into experimental mice ddK. In this experiment, 80 per cent of the ddK mice suffering from Friend virus disease died within 100 days. To investigate irradiation effects in the process of this disease, several ways of total-body irradiation were employed, and enlargement of spleen, mortality, and histological findings were observed. Single and fractionated irradiation were used. Single irradiations of 500 r, 300 r, and 200 r and fractionated irradiations of 500 r total dose (100 r/5 days and 50 r/10 days) and 300 r total dose (100 r/3 days and 50 r/6 days) were performed. The influence on the mortality was almost negligible except in the single 200-r irradiation group. The suppressive effects on splenomegalia, however, were quite remarkable in all irradiated cases, especially the single 500-r irradiation group. The histological findings are compared and discussed. (auth)

31202 FIFTY-FOUR CASES OF SKIN AND NECK CANCER FOLLOWING RADIATION THERAPY FOR BENIGN DISEASES. Takashi Kitabatake (Nagoya City Univ., Japan) and Shinji Takahashi. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1303-11(Jan. 1964). (In Japanese)

Sixty-one cases of radiation-induced cancer were collected from all Japan in 1961 to 1962. Of 61 cases, 54 were cancer of skin or neck including the thyroid gland. All these cancers were developed in the area irradiated for treatment of benign diseases such as tuberculosis of cervical nodes, thyroid adenoma, eczema, or favus over three years ago. The ratio of male to female was approximately the same as natural cancer. However radiation-induced cancers tend to develop at younger ages than natural cancers. This was definitely seen in thyroid cancer. The latent period was between 3 and 47 years with an

average of 20 years. The frequency distribution of the latent period showed nearly the normal logarithmic curve. The latent period tended to increase with a decrease of radiation dose in tissue. About half of the original diseases were tuberculosis of the cervical lymph nodes. Thyroid adenoma and various skin diseases followed in this order. (auth)

31203 CLINICAL AND EXPERIMENTAL STUDIES ON RADIATION-INJURY TO TASTE. Kazuo Tanikawa (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 704-12(Sept. 1963). (In Japanese)

In clinical experiments taste injuries caused by irradiation by gamma rays from ^{60}Co were examined in 30 patients, using the drop method of aqueous solutions of sucrose, acetic acid, sodium chloride, and quinine hydrochloride. Taste injury was recognized at doses from 1000r to 4000r, but complete loss of taste was not observed below a dose of 3000r. The average dosage and average time for the complete loss were about twice those for the beginning of the injury. In complaints of loss of taste, some difference was observed among the above methods, and in some cases the results were doubtful. The tastes completely lost were recovered 30 to 40 days after irradiation. In animal experiments CF_1 mice weighing 16 to 18g were used and taste injuries were examined by the daily intake of distilled water and 2% salt solution, which they never took normally. The mice were irradiated by x rays. In the case of single doses, the higher the dose, the sooner occurred the taste injury. Injury was not observed below a single dose of 1500r. When irradiated with divided dosage, no injury was observed below 1980r in 6 days. In the case of single doses, the injury persisted for 12 to 22 days, and the taste was gradually recovered. In the divided irradiations, the taste injury was repaired sooner. (auth)

31204 RADIOSENSITIVITY OF MALIGNANT TUMOR. 2ND REPORT. BREAST CANCER. Takeshi Hatayama and Hiroshi Asakawa (Tohoku Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1173-8(Jan. 1964). (In Japanese)

Radiosensitivity of breast cancer was investigated in some respects, such as tumor site, histopathological type, and cytological structures. Eighty breast cancer patients with histological diagnosis were studied. Of them, 30 patients had carcinoma simplex, 45 had adenocarcinoma, and the rest had carcinoma of other types. Carcinoma simplex seemed to be more sensitive than adenocarcinoma. About two thirds of carcinoma simplex cases and about two fifths of adenocarcinoma cases responded to irradiation from 3000r to 6000r. Some cases of carcinoma simplex responded to doses less than 3000r (2 cases responded to doses under 1000r), but in adenocarcinoma only one case responded to 3000r. Radiosensitivity of lymph node metastasis (axillar and supraclavicular) was higher than that of locally recurrent tumors in both histological types. No significant relation between radiosensitivity and cytological structures was found, but cancer cells with high atypia seemed to be more sensitive than those with low atypia. (auth)

31205 SOME PROBLEMS ON EPIDEMIOLOGICAL METHOD OF RADIATION-INDUCED CANCER. Takashi Kitabatake (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1271-6(Jan. 1964). (In Japanese)

Some problems on the epidemiological study of radio-induced cancer, particularly on the prospective survey, are discussed. When matched sampling was adopted, the minimum number to be surveyed was calculated as $N \geq [7(k+1)(2-k-1)/2(k-1)^2]$ for obtaining the statistically significant difference at the level of 1%, where 1 was cancerogenic rate in the irradiated group and k the same rate in the control group. If the response rate was to be c in both groups, $N\ (1-k-1+c)\ \sqrt{7}\ \sqrt{N\ (1+1+k-c)}$ was needed. Under the conditions of $k = 1.5/10^4$, $1 = 10k$, $N = 10{,}000$, c was limited as follows: $d \geq 30/10^4$. If non-matched sampling was taken, the number to be surveyed was limited as $N_1 > [91/(1-k)^2]$ in the irradiated group and $N_2 \geq [9kN_1/N_1(1-k)^2 - 91]$ in the control group. (auth)

31206 STATISTICAL ANALYSIS OF 1961 SURVEY IN STUDY ON RADIATION-INDUCED CANCER IN HUMAN BEINGS. Motosaburo Masuyama (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1299-1302(Jan. 1964). (In Japanese)

A statistical analysis was performed on a 1961 survey of radiation-induced cancer in human beings based on tables classified according to sex, age, and histories of irradiation in cancer and control groups. Details are in the main text published elsewhere by Dr. S. Takahashi. Values of chi-square were calculated using information statistics techniques. Actual procedures for calculation of main effects and interactions are detailed. (auth)

31207 STUDIES ON SOME IMMUNOLOGIC ASPECTS OF BONE MARROW TRANSPLANTATION. Kazumasa Yamada (Nagoya Univ., Japan) and Eishi Wakayama. Nippon Ketsueki Gakkai Zasshi, 24: 702-15(Dec. 1961). (In Japanese)

The dose-response relation between the amount of bone marrow injected intravenously and 30-day survival after x-ray exposure was studied by homologous and heterologous grafting experiments. The optimum dose of rat bone marrow that protects lethally irradiated mice is about 10 times that of homologous marrow. Persistence of heterologous bone marrow in mice was studied by imprints of bone marrow and spleen from x-irradiated mice given rat bone marrow. Data confirmed the repopulation theory as the mechanism of action of the injected bone marrow and show that the degree and time of death of the treated animals depend on the dose. In a heterologous system, using Sprague-Dawley rats as donor and C3H mice as host, infusion of various doses of splenic cells of adult rats did not keep lethally irradiated mice alive. Splenic cell homogenates also showed no effect on survival. However, when infused with splenic cells from 4-hr-old rats, 90% of lethally irradiated mice survived over 80 days; no such protective effect was observed with cells from over 80 days; no such protective effect was observed with cells from 72-hr-old rats. This suggests that the transferred antibody-forming cells acquired immunologic tolerance toward the host. In lymph node cell transfer experiments, alteration of homograft response by treatment with steroid hormones and carcinostatic agents were studied, in comparison to that by x irradiation. Lymph node cells obtained from rabbits previously injected with Shigella flexneri were transfered to homologous recipient animals treated with x rays or various agents prior to transfer of cells. In the sera of the latter, agglutinins to Shigella were served as the measure of the transplantation reaction of the recipient tissue. Among those agents tested, lethal doses of x rays (950 r) and a large doses of cortisone and Nitromin were found to suppress the immunologic reaction of the host. (BBB)

31208 BONE-MARROW INJURY FOLLOWING INJECTION OF THOROTRAST. S. Halvorsen and S. Sander. Nord. Med., 70: 1320-1(1963).

A case report is given of a female epileptic patient who

17 yr after cerebral angiography with Thorotrast developed anemia with leukopenia and thrombopenia. She died in a septic state and necropsy revealed generalized plasma-cell infiltration in the bone marrow. Deposits of Thorotrast were demonstrated in the spleen, lymph nodes, liver, and bone marrow that gave off α radiation, which was shown autoradiographically. The x-ray picture was characteristic. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31209 CLINICAL AND MORPHOLOGICAL FEATURES OF RADIATION CATARACTS COMPARED WITH EXPERIMENTAL CATARACTS OF OTHER ETIOLOGY. A. N. Faddeev (Scientific Research Experimental Inst. of Eye Diseases and Tissue Therapy, Academy of Medical Sciences, Ukrainian SSR). Oftal'mol. Zh., 18: 340-3(1963).

Cataracts induced in the eyes of rabbits by x radiation, alloxane, naphthalene, and trauma were studied during the early developmental stages by the use of ophthalmoscopes and slit lamp. The rabbits were sacrificed at various times after application of the cataractogenic agents. It was concluded that early clinical signs and early histological changes were specific for each cataractogenic factor. Cataracts induced by x radiation were characterized by early morphological changes that were present before any clinical signs were observed. The initial morphological changes in radioinduced cataracts were in the epithelium of the frontal capsule and were characterized by atypical forms of cell division and disordered epithelium differentiation in lens fiber. (TCO)

31210 ULTRASTRUCTURAL ALTERATIONS IN X-IRRADIATED SPLEEN. W. A. Bari and G. D. Sorenson (Washington Univ., St. Louis). Pathol. Microbiol., 27: 257-75(1964).

The morphologic and functional effects of external irradiation on lymphoid tissue at the cellular level were investigated by light and electron microscopy in adult male Sprague-Dawley rats exposed to an LD_{50} of 600 r whole-body x-irradiation. Simultaneous changes within the nuclei and cytoplasmic organelles of some splenic lymphocytes were observed as early as 75 min postirradiation. The ultrastructural changes within the mitochondria and nuclei were probably related to the enzymatic changes within these cellular constituents. The destructive process was progressive and became extremely severe by 10 hr after irradiation. At that time nearly all lymphocytes were destroyed leaving the radioresistant reticular cells and hyperactive macrophages intact. The latter contained large numbers of disintegrated lymphocytes and erythrocytes, seen as degenerating osmiophilic membranes presumably composed of phospholipid. Phagocytic activity was apparently increased as early as two hr following irradiation. Macrophages were more numerous than usual and contained pyknotic lymphocytes, erythrocytes, and ferritin particles. (BBB)

31211 COMPARATIVE EFFECT OF COBALT^{60} ON PLANT CHARACTERS OF TWO RECOMMENDED PHILIPPINE LOWLAND RICE VARIETIES. Filomena F. Campos and Emelita G. Velasco. Philippine Agriculturist, 46: 93-100(1962).

Subjected to different dosage levels of γ rays, Peta and Tjeremas varieties have relatively different radiosensitivity. Germination in Peta was significantly affected at 10 kr and 20 kr and in Tjeremas at 20 kr. A highly significant reduction in seedling survival was observed at dosage range of 1 kr to 20 kr for Peta and 5 kr, 10 kr, and 20 kr for Tjeremas. Similarly, a significant increase in panicle length was noted at 1 kr for Peta and at 1,5 kr, 2,5 kr, 10 kr, and 20 kr for Tjeremas. The percentage of filled grain was inversely affected at dosage levels of 10 kr and 20 kr for Peta and 5 kr, 10 kr, and 20 kr for Tjeremas. Straw weight of Tjeremas was unaffected by the treatment, whereas, that of Peta was significantly increased by the 20 kr level. In both varieties, all dosage levels showed a significant reduction in height at harvest but did not affect productive tiller and seed weight. A similar pattern was exhibited by both varieties in panicle number: significant increases at dosage range of 0,5 kr to 1,5 kr and a decrease at the dosage range of 2,5 kr to 20 kr. A few chlorophyll-deficient plants which did not survive beyond transplanting stage were observed among the X1 generations in both varieties. (auth)

31212 CARCINOMATOUS COMPLICATION IN RADIODERMATITIS. E. F. Malbec, J. V. Quaife, and H. A. Vieyra Urquiza (Ramos Mejía Hospital, Buenos Aires). Plastic Reconstruc. Surg., 32: 447-50(1963).

A brief comment on the histology and pathogenesis of malignant degeneration in radiation burns is followed by a description of 12 neoplastic complications out of 82 cases. Biopsy seems to be the only means of correct diagnosis before it is too late for radical excision. It is suggested that the incidence of chronic radiodermatitis and cancer might be reduced if doctors limited radiotherapy to those diseases in which no other treatment is available. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31213 COMBINED EFFECTS OF VIBRATION AND IONIZING RADIATION. Z. I. Ananasenko and M. A. Kuznetsova. Probl. Kosmich. Biol., 3: 269-77(1964).

Experiments were performed on guinea pigs and the C-57 strain of black mice in order to determine the combined effects of vibration and radiation on the survival of the function of the vestibular nerve and the latent period of the flexor reflex. Acute whole-body irradiation was carried out by means of gamma rays from ^{60}Co. The dose was 500 r for guinea pigs and 600 and 750 r for mice. The dose rate was 261 r/min. The animals were subjected to a vibration of 70 cps with an amplitude of 0.4 mm for 15 min. Animals were divided into four groups. The first group was subjected to two periods of vibration but was not irradiated. The second group was exposed to a single dose of radiation but no vibration. The third group was subjected to vibration both before and after irradiation. The fourth group served as controls. Vibration and irradiation taken separately or combined brought about significant changes in the normal values of the parameters studied. In some respects, vibration produced greater changes than the lethal dose of radiation to which the animals were subjected. In all cases of combined irradiation and vibration, it was found that vibration substantially changed the effects of radiation on the organism. When the animals were subjected to the combined effects of irradiation and vibration, the death rate increased and the life span decreased to a greater degree than when they were exposed to radiation alone. The effects of the combined action of irradiation and vibration on the central nervous system were complex. Individual functional indices of the central nervous system examined showed the separate effects of each of these two stress factors. If both vibration and irradiation shifted the parameters of a given index in one direction, their combined action exceeded the effects of irradiation alone. If these stimuli acted in opposite directions, the effect of their combined action could be less than, or even qualitatively different from, that of irradiation alone. (A.I.D. Press)

31214 EFFECT OF IONIZING RADIATION ON THE VESTIBULAR ANALYZER. A. A. Sveshnikov and A. V. Sevan'kaev. Probl. Kosmich. Biol., 3: 355-65(1964).

Experiments were performed to determine the amount of ionizing radiation required to effect the first functional changes in the vestibular nerve in the inner ear. Dogs and rabbits were subjected to gamma irradiation in doses ranging from 50 to 5000 r. Another group of dogs was irradiated with protons ranging from 500 to 350 r (proton energy, 510 Mev). Threshold sensitivity and reactivity were determined by means of a rotating device. Vestibulograms were plotted. It was found that small doses of radiation (50 to 100 r) tend to increase the excitability of the nerve. A dose of 200 r was considered as threshold because the first regular decrease in labyrinth excitability was observed. Higher doses led to a considerable inhibition of the function of the vestibular mechanism. (A.I.D. Press)

31215 EFFECTS OF X-RAY IRRADIATION ON LILIUM FORMOSANUM. Muneo Iizuka and Akiko Ikeda (Kyoto Univ.). Proc. Am. Soc. Hort. Sci., 82: 508-16(1963).

Lilium formosanum seeds were exposed to x-ray dosages of 600 to 9600 r. Selections were made with special reference to flower type and size, and earliness of maturity. In the X_2 generation, deformed flower types appeared consisting of club-shaped petals. Large-sized, heavy textured flowers segregated in the X_2 and X_3 generations. In the X_3 generation, deformed flower types consisting of club-shaped petals and sepals appeared. The flower deformities were usually not completely stable, occasionally, different type deformities appearing in the same plant. (auth)

31216 EFFECTS OF X-IRRADIATION ON ELECTRO-SHOCK CONVULSIONS IN THE DEVELOPING NERVOUS SYSTEM. A. Vernadakis (Univ. of California, Berkeley). Proc. Western Pharmacol. Soc., 6: 33(1963).

In Long-Evans rats the action of radiation on electroshock seizure responses was studied between the 8th and 55th days of age. The animals were exposed to a single dose of 500 r of whole-body x irradiation given at a rate of 25 r/min as measured in air. The seizure patterns produced by stimulation of the brain through corneal electrodes with a current of 50 ma are described. In irradiated rats the full flexor-extensor seizure pattern appeared in 50% of the animals at 13 days of age, three days earlier than in controls. In both control and irradiated rats the durations of flexion, clonus and total seizure progressively decreased, and the duration of extension progressively increased up to 22 days of age. This indicates increased neuronal activity as the brain matures. Extension was longer and flexion, clonus, and total seizure were shorter in irradiated than in control rats. The duration of flexion is a standard index of seizure intensity; thus, irradiation increased brain activity in developing rats. However, the shorter durations of clonus and total seizure indicate that irradiated rats are unable to sustain this increased brain activity after electrical stimulation. Throughout the experimental period a current of 50 ma elicited hindlimb extension in a higher percentage of irradiated animals than in controls. Thus, exposure to irradiation during early postnatal development appears to have long-lasting effects on brain activity. In normal developing rats the time of appearance of the full flexor-extensor seizure parallels active myelination and other chemical manifestations of the developing brain. The earlier appearance of a full seizure pattern in irradiated rats suggests that the developing nerve fibers are better able to carry repetitive impulses, a property characteristic of myelinated fiber. The degree of maturity of synapses in the developing brain may be another factor influencing the time of appearance of a full seizure pattern in developing rats. Sufficient data are not presently available to decide whether or not irradiation accelerates the maturation of synapses. (BBB)

31217 EFFECTS OF RADIATION ON THE DEVELOPING EMBRYO AND FETUS. Samuel P. Hicks and Constance Joan D'Amato (Univ. of Michigan, Ann Arbor). Progr. Gynecol., 4: 58-74(1963).

The effects of radiation on developing embryos and fetuses are reviewed on the basis of results of animal studies and observations on Japanese children irradiated in utero as a result of the atomic bomb explosion in 1954. Topics discussed include the genetic effects of radiation in embryonic and fetal gonadal cells; direct effects of various doses of radiation during the various developmental stages of fetuses and embryos, illustrated mostly with animal experiments; and radioinduced somatic mutations. A timetable is presented of expected malformations in rats resulting from various radiation doses during development from the 9th to the 20th day of gestation. Emphasis is placed on malformations resulting from irradiation of the fetal brain. (C.H.)

31218 EFFECT OF TEMPERATURE ON THE FREQUENCY OF CHROMOSOME MUTATIONS IN GAMMA-IRRADIATED SEEDS. N. I. Shapiro and E. M. Protopopova. Radiobiologiya, 4: 270-4(1964). (In Russian)

A short heating of moistened barley seeds before γ irradiation is known to decrease the percentage of radioinduced aberrations. Data are presented which show that this effect takes place only in the presence of O and that the O effect is present only when the heating of the seeds takes place before the irradiation. The presence of β-alanine during the heating did not have any protective effect. Two explanations are offered: The heating of the seeds may decrease the O concentration, or it may alter the properties of the cell membrane, making it less permeable to O. β-Alanine does not show post-irradiation protective effects in the absence of a supplementary saturation with O of the water with which the seeds are moistened. The value of the coefficient of protection is highest for heated seeds, which is in agreement with the suggestion that the protective effect is due entirely to the removal of O. The temperature effect is really a modification of the O effect, and the increase in radiation resistance of barley seeds heated before irradiation is related to their protection from post-irradiation damage by the action of O. The results were evaluated from the percentages of broken chromosomes observed in cells in the anaphase stage of division. (TTT)

31219 HISTOCHEMICAL STUDIES OF ASCORBIC ACID IN THE BRAIN AND SPINAL CORDS OF IRRADIATED DOGS. M. S. Gzelishvili and V. M. Abdullaev (Inst. of Röntgenology and Radiology, Baku, USSR). Radiobiologiya, 4: 275-8(1964). (In Russian)

Dogs (weighing up to 11 kg) were whole-body x-irradiated to 600 r in a single dose; another group (weighing up to 13 kg) was given 6048 r per dog in 12 doses over a 2-month period. Fifteen days after the whole-body irradiation, the ascorbic acid in the cerebellum was significantly lower in the molecular layer; distribution in the granular layer was very unequal, giving this layer a marbled appearance. In some Purkinje cells ascorbic acid was concentrated at points instead of being diffuse in the protoplasm, while in others ascorbic acid was absent. In the endothelium of the capillaries and small vessels, the ascorbic acid concentration was higher than normal. In the cortex of the large

hemispheres, granules of ascorbic acid accumulated in the molecular and granular layers as well as in the nerves and nerve fibers. In the cells granules were coarser and gathered around the nuclei. In the large ganglion cells granules were coarser and darker when present but were absent from most cells. In the diencephalon changes were very complex. In the divided-dose series, animals were sacrificed at various times. Changes in the ascorbic acid distribution were most marked in the parts irradiated directly. The results are interpreted to indicate a trophic function of the cerebellum and a role in metabolic processes. Four plates are shown. (TTT)

31220 POSSIBLE EFFECT OF LYSIS OF IRRADIATED YEAST ON THE EXPERIMENTAL CURVES OF THE RECOVERY PROCESS. V. I. Korogodin, N. M. Kabakova, N. N. Perestoronina, Yu. V. Sokolov, and S. Ya. Kholeva (Medical Radiological Inst., Obninsk, USSR). Radiobiologiya, 4: 289-96(1964). (In Russian)

Theoretical and experimental work on the possible effect of lysis of irradiated yeast cells, incubated in a nonnutrient medium, on the dynamics of postirradiation recovery is presented. Comparison of the recovery curves determined by both micro and macro methods indicates whether the lysis affects the course of these curves and what type of lysis predominates in the irradiated population, that is of the lethally or the nonlethally damaged cells. Experimental data on strains of the yeast Saccharomyces vini and S. cerevisiae showed that lysis has practically no effect on the shape of the recovery curves in an 8- to 9-day incubation after irradiation in sterile tap water at 30°C. Under these conditions, in the indicated time, lysis of the strains used was slight or nonexistent. In some other strains lysis markedly affects the shape of the recovery curves, principally the nonlethally damaged cells. The cell recovery process for these strains is better represented by curves obtained by a microcolony method. The plateau in the recovery curves of all strains of yeast studied indicates the existence of a real nonreversible component and not the participation of lysis, as has been assumed. (TTT)

31221 EFFECT OF SEED STORAGE TEMPERATURE AND OXYGEN TENSION ON RADIATION EFFECTS. P. K. Shkvarnikov and I. V. Chernyĭ (Inst. of Cytology and Genetics, Novosibirsk, USSR). Radiobiologiya, 4: 297-305(1964). (In Russian)

Air-dried seeds of summer wheat were γ-irradiated with up to 25 kr or 4×10^{12} thermal neutrons/cm^2, and portions were stored for 30 days: in air at room temperature, in air at 40°C, or in 60% O at room temperature. The frequency of changes in the second-generation descendants decreased from 23.5 to 15% with increasing dose from 1 to 15 kr. Unirradiated seeds stored at 40°C showed 8.5% mutations. The combined effect of γ irradiation and storage at 40°C was a decrease in the mutation frequency. Seeds irradiated with low γ doses and stored in O showed a lowered mutation frequency, which decreased with increasing dose. In portions irradiated with 10 to 15 kr and stored in O, mutations were a little higher than in portions stored in air. The effects on mutation frequency in the M_2 plants of storage of irradiated seeds at 40°C and in 60% O were similar to the above. Thermal-neutron irradiation showed opposite effects, with increasing frequency of mutations. The spectrum of mutations resulting from different conditions of irradiation and storage is tabulated. In the experimental production of mutations for selection purposes, the effects on the seeds of several mutagenic factors should be considered. (TTT)

31222 RADIATION STIMULATION OF CELL DIVISION. I. CHANGES IN THE MITOTIC INDEX IN PEA ROOTS AFTER LOW-DOSE X-IRRADIATION OF CELLS. Yu. F. Bogdanov and T. V. Borovkova (Inst. of Radiation and Physical-Chemical Biology, Moscow). Radiobiologiya, 4: 306-12(1964). (In Russian)

Pea seeds were irradiated with 46 to 276 r at a rate of 23 r/min and are subsequently sprouted. Root tips were fixed in alcohol–acetic acid, stained, and examined. From the data the mitotic index was determined. At 16 to 18 hr, there were no mitoses in the control root tips. Doses of 69, 138, and 276 r increased the mitotic index 1.2 to 1.6 fold in the first 28 hr after irradiation over that in the controls. This was the maximum, and it corresponds to the first mitosis after sprouting, appearing simultaneously with the first mitosis after irradiation. The chromosome aberrations in the anaphase from the 46-r-irradiated seeds were represented, out of 242 anaphase cells studied, by three fragmented and no bridged forms. The data indicate that the increase in the mitotic index is not the result of an inhibition in the mitotic phases or a compensation for the delay of entry of the cells into the first mitosis, but rather reflects an acceleration of the cell division by a shortening of the interphase. The numbers and the percentages of the cells in the various phases and the number of mitoses, as well as the number of rootlets, at different times after different doses are tabulated. (TTT)

31223 USE OF FAST NEUTRONS IN SELECTION OF ERYTHROMYCIN-PRODUCING ACTINOMYCES ERYTHREUS. V. G. Zhdanov and S. I. Alikhanyan (Kurchatov Inst. of Atomic Energy, Moscow). Radiobiologiya, 4: 313-21(1964). (In Russian)

The effectiveness of fast neutrons in inducing mutations for increased formation of antibiotics in Actinomycetes was studied and compared with the effectiveness of other widely used agents, uv radiation and diethyl sulfate. Suspensions of Actinomyces erythreus were irradiated with fast neutrons at a temperature of 38.5°C and observed after 10 days' culture. With increasing doses of fast neutrons from 0 to 50 krad, the viability of the organisms decreased exponentially. The relative biological effectiveness of fast neutrons was five times that of x rays. Doses of 40 to 50 krads resulted in formation of dwarf and black colonies, with no increase in antibiotic activity. Statistical treatment of the data and comparison of the antibiotic-forming activity with that of uv radiation showed an 8-fold greater number of positive variants with 2000 ergs/mm^2 of uv radiation than with 20 krads of fast neutrons, but the same number with 400 ergs/mm^2 and 40 krads. Fast neutrons were more effective than diethyl sulfate in causing positive variants, while a combination of uv irradiation and diethyl sulfate was more effective than either uv or diethyl sulfate alone. A strain of organisms was developed with 60 to 70% higher antibiotic activity than the original strain. (TTT)

31224 PRODUCTION BY IONIZING RADIATION OF MUTANTS RESISTANT TO SMUT AND KERNEL SMUT IN WINTER WHEAT. S. A. Valeva (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 322-8(1964). (In Russian)

Air-dried wheat seeds were γ irradiated from Co sources with doses of 10 to 20 kr. In the fall of 1958 they were planted. The plants were artificially infected with smut (Ustilago tritici (Pers) Jens) and with kernel smut (Tilletia tritici Wint) spores. In the summer of 1961, in the M_3 plants, 29 groups (each group was from a different M_1 seed) were found without any smut-infected plants. In the other 1086 groups, 40 to 80% of the plants were infected.

These 29 were from 15 M_2 groups that had included some infected plants. The percentage of resistant plants was highest from the seeds irradiated with a 10-kr dose. Five were found in the M_3 plants that were undamaged by kernel rust, there being 430 infected plants. The characteristics of the resistant mutants are tabulated. They include approximately cylindrical spikes, 21 to 23 spikelets, and 60 to 70 kernels in the spikelet. Kernels are round, with shallow ridges, are glossy, and are of average size. The stems in a cluster are uniform in height, and second growth is almost absent. Damage from mildew and blight is slight. (TTT)

31225 ACTION OF RADIATION ON LIVING ORGANISMS AND VARIOUS MATERIALS. Libero Polzonetti (Università, Camerino, Italy). Rend. Inst. Sci. Univ. Camerino, 4: 40-7(1963). (In Italian)

Radiation effects on living organisms and other materials are reviewed. The action of radiations on tissues and the physical- and physio-chemical alterations of the materials are described. (auth)

31226 STUDY OF FOUR CASES OF TOTAL IRRADIATION BY RADIOACTIVE COBALT (AT RESPECTIVE DOSES OF 250, 400, AND 600 RAD) PRELIMINARY TO ALLOGENIC KIDNEY TRANSPLANTATION. R. Kuess, M. Legrain, G. Mathe, et al. (Centre Medico-Chirurgical Foch, Suresnes, [France] and Institute Gustave-Roussy, Villejuif, France). Rev. Franc. Etudes Clin. Biol., 7: 1028-47(Dec. 1962). (In French)

Four patients with chronic renal failure were γ irradiated with ^{60}Co, receiving 250, 400 (2 patients), and 600 rad as pretreatment for allogenic kidney transplantation. Only symptomatic treatment was otherwise given: strict aseptic care, use of antibiotics only with proven infection, and regular platelet transfusions. The course of injuries following therapy is described. (TCO)

31227 THE REPORT OF A CASE OF EXTREMELY RADIOSENSITIVE CHILD'S MALIGNANT LYMPHOMA. Takeo Okuyama (Tokyo Medical and Dental Univ.) and Yasuo Hozaka. Rinsho Hoshasen, 8: 442-51(June 1963). (In Japanese)

The case occurred in a boy 5 years and 5 months old. He was radiation-treated for the initial symptoms of mediastinal tumor and right axillary lymph node swelling. Following these symptoms, swelling of the right chest wall, pleural exudation, ascites, left lagophthalmus, swelling of the left side of the face and left supraclavicular lymph nodes occurred in succession, and these were x-ray treated. The swellings, pleural exudation, and ascites disappeared at the minimum doses of 100–400r (air dose). After that, left submandibular lymph node swelling, 10 or more nodular swellings of the scalp, and exophthalmus of both sides occurred, and pleural exudation and ascites frequently recurred. Except the pleural exudation and ascites, all of these were extremely radiosensitive. The patient died 7 months after the occurrence of the initial symptoms in spite of the radiosensitivity of the tumors. No autopsy was performed, but the disease was diagnosed as a malignant lymphoma from the cytological findings of pleural exudation and the histological findings of biopsy of gingival tissue and right axillary lymph node. The case is thought to be a very radio-sensitive tumor because the doses of 100–400r by x rays were very effective. (NSA of Japan)

31228 MULTIDISCIPLINARY STUDIES IN SPACE RADIATION EFFECTS. Irving J. Russell. RTD Technol. Briefs, 2: No. 7, 3-9(July 1964).

Problems involved in radiobiological studies of the environment that will be encountered by astronauts in space are reviewed. It is pointed out that neither the physicist nor the radiobiologist can arrive at the solution to these problems unaided by the other. A flow chart is presented for space radiological studies of the Biophysics Branch of the Air Force Weapons Laboratory and results to date are summarized. The program is based on the importance of the simultaneous measurement of biophysical and physical parameters of solar flare and other space radiations. Three major satellite experiments are reported in which the satellite payload contained particle spectrometers for measuring flux, spectrum, and angular distribution of electrons, protons, and α particles in space; tissue-equivalent ion chambers for absorbed depth-dose determinations; and linear energy transfer (LET) spectrometers to obtain a measure of the ionizing power, and therefore, of the biological effectiveness of the radiations. Mathematical models and codes were developed to describe radiation interactions with shields and depth-dose and LET profiles for typical solar flare fluxes and spectrums. These codes are also used in the design and placement of radiation sensors in satellite packages. Results are summarized from studies on dosimetry and the effects of partial- and whole-body exposure of sheep to a prompt fission spectrum neutron source giving a neutron to γ dose ratio of about 5/1 at the position at which the animals were placed. Associated experiments were conducted with 250 Kvp x rays for comparison. Results gave a bilateral $LD_{50/60}$ of 530 ∓ 30 rads midline air dose for fission spectrum neutrons and a bilateral $LD_{50/60}$ of 390 ∓ 20 rads midline air dose for 250 Kvp x rays. The critical organ responsible for death appeared to be the gastrointestinal system following neutron exposure and the hematopoietic system following exposure to x radiation. Implications of these findings in planning for space flight are discussed. (C.H.)

31229 INFLUENCE OF THE LONG-TERM EXPOSURE TO A HIGH FREQUENCY FIELD ON THE INCORPORATION OF OSTEOTROPIC RADIOISOTOPES Ca^{45} AND P^{32} INTO BONY TISSUE OF THE RABBIT. O. Riedl, M. Spala, J. Kacl, J. Kolar, A. Babicky, and M. Jilek. Sb. Lekar., 12: 357-64(1963). (In Czech.)

The influence of high frequency field on the metabolism of bone in rabbits was investigated using the method of 48-hour incorporation of ^{45}Ca and ^{32}P. To twenty-three from a total of 38 animals tolerance doses of high frequency field were applied to the region of the right knee on alternate days (three times a week) for a period of twelve weeks. Fifteen rabbits formed a control group which was not exposed to a high frequency field. The assessed activities of bone specimens from the region of the right and left knee were evaluated by mathematical and statistical methods, by comparing differences between the right and left side, and by comparing individual weeks of exposure. The results confirm previous conclusions that under the above set-up it is impossible to provide evidence of the adverse effect of long-term repeated exposure to high frequency fields on the mineral metabolism of bone in the genual region of the rabbit. (auth)

31230 CHANGES IN THE CONDUCTIVITY OF SERUM AFTER EXPOSURE TO SINGLE DOSE OF WHOLE-BODY X-RAY IRRADIATION OF THE RABBIT. V. Hlavaty and M. Zak (Charles Univ., Prague). Sb. Lekar., 66: 111-15 (1964). (In Czech)

Rabbits weighing 2.5 kg were exposed to 200-kv x rays at a dose of 1000 r and a rate of 10 r/min, and changes in the electric conductivity of serum, sampled at postirradiation

intervals of 15 min to 48 hr, were determined. In vitro studies were also conducted on serum samples irradiated at doses of 1000, 5000, 10,000, 25,000, and 50,000 r. It was found that in irradiated animals a maximum increase of conductivity of serum developed 4 to 6 hr after irradiation with a single whole-body dose of 1000 r. Changes in the electric conductivity of serum, i.e., a rise, were observed within 15 min after irradiation, and these changes persisted for two days after irradiation. The lowest rise in serum conductivity was found at two and 36 hr. These postirradiation changes in the serum conductivity are presumably due to an altered concentration of serum ions, particularly chloride, sodium, and potassium. In serum irradiated in vitro with doses of 1000 to 50,000 r, no significant changes in electric conductivity were found; the very slight drop in conductivity at the higher doses was not significant. The altered blood-tissue electrolyte balance after irradiation is discussed. (BBB)

31231 ACTION OF IONIZING RADIATION ON PLANTS. N. F. Batygin. Sb. Tr. po Agron. Fiz., Vses. Akad. Sel'skokhoz. Nauk, No. 10, 14-21(1962). (In Russian)

Various processes were studied in growing plants irradiated with ≦ 1000 r. Protoplasmic viscosity was found to decrease 15 min post-irradiation, but a sharp increase resulting ultimately in normality was noted after one hr. Corresponding to lowest viscosity, were increases in respiration and decreases in ascorbic acid and sugar contents. As protoplasmic viscosity increased, respiration became attenuated, and sugar, protein, and ascorbic acid contents increased. Enzyme activity decreased with the initial response to irradiation. (H.M.G.)

31232 FUSION OF DIFFERENT BODY SEGMENTS, USING X-RAY-IRRADIATED ANIMALS AND NON-IRRADIATED ONES IN A FRESHWATER PLANARIAN, BDELLOCEPHALA BRUNNEA. Wataru Teshirogi. Sci. Rept., Fac. Lit. Sci., Hirosaki Univ., 10: No. 1, 1963.

The problem of determination of blastema, the potency of neoblast, and the cellular migration during regeneration by grafting pieces from x-irradiated animals on pieces from nonirradiated ones was investigated in a freshwater planarian, Bdellocephala brunnea. Although the 8000-r irradiated animal or a piece of it continues to live for some time after the x irradiation, it lost its power to regenerate. When a piece from the pre-pharyngeal region of an 8000-r irradiated animal was grafted on the posterior half of the body, which originally was unable to regenerate the head, a head was regenerated from the anterior of the fused piece, although the rapidity of head regeneration was delayed compared to the control. In the x-irradiated anterior component of the fused piece neoblast was rarely recognized in early stages after fusion, but it gradually increased with time. Neoblast, however, clearly decreased in the posterior component until the 35th day after fusion. When the length of the anterior component of the fused piece was shorter, the speed of head formation was more rapid than in a fused piece with longer anterior component. The piece from the pre-pharyngeal region of an x-irradiated animal was not disintegrated during regeneration by grafting with a non-irradiated piece, and continued to live for a long time. (auth)

31233 ULTRAVIOLET INACTIVATION OF CHLOROPLAST FORMATION IN SYNCHRONOUSLY DIVIDING EUGLENA GRACILIS. Stephen F. Petropulos (Princeton Univ., N. J.). Science, 145: 392-3(July 24, 1964).

Ultraviolet inactivation of chloroplast formation was studied in synchronously dividing cultures of Euglena gracilis. Sensitivity to sublethal doses given at intervals throughout the cell cycle was greater just before cell division than during division. There was approximately a twofold difference in the dose-response relations for the periods of high and low sensitivity. (auth)

31234 HOMOGRAFTS IN THYMECTOMIZED, IRRADIATED MICE: RESPONSES TO PRIMARY AND SECONDARY SKIN GRAFTS. William E. Davis, Jr., Marvin L. Tyan, and Leonard J. Cole (Naval Radiological Defense Lab., San Francisco). Science, 145: 394-5(July 24, 1964).

Adult thymectomized, irradiated mice restored with syngeneic bone marrow exhibit an accelerated response toward second-set skin homografts, although the response to the primary grafts is impaired. Such mice have a long-lasting impairment (up to 223 days) of the primary response to allogeneic grafts (but not to xenogeneic grafts) and show the greatest deficiency of response toward grafts sharing the same H2 locus as the host. Thymectomy in the adult mouse is ineffective in altering a state of homograft sensitivity induced prior to irradiation. (auth)

31235 REDUCTION OF TRIPHENYLTETRAZOLIUM CHLORIDE BY THE CELLS OF PROTEUS VULGARIS AFTER THE ACTION OF BENZENE AND X RADIATION. M. Ryc (Purkyne Univ., Brno). Scripta Med. Fac. Med. Univ. Brun. Olomuc., 36: 61-73(1963). (In Czech.)

A study was made of the reduction of a lower concentration of 2,3,5-triphenyltetrazolium chloride (TTC) than is generally used, after the prior use of substances affecting the permeability of the cell. The reduction of 0.02% solution of TTC by the cells of Proteus vulgaris was followed in treatment with benzene or x rays doses of 250 to 5000 r. Benzene at low concentrations increased the reduction of TTC, accompanied by a corresponding fall of the concentration of TTC in the medium as a result of increased cell permeability. Similar results were obtained in the broth culture and in the presence of specific substrates, and were observed after x irradiation of cells (250 to 750 r) in broth culture and in the presence of glucose or formate. Doses of 3000 to 5000 r caused a drop in the reductive activity of the cells. Within the first hour after irradiation, no secondary effects of radiation on the reduction of TTC by Proteus cells were observed. On the basis of these results it is concluded that the increased reduction of TTC brought about by low doses of benzene and x rays can be regarded as a result of increased permeability of the cytoplasmic membrane. (BBB)

31236 ELECTRON-SPIN-RESONANCE IN IRRADIATED BACTERIOPHAGE AND THEIR CONSTITUENTS. [PART] II. Wolfgang Koehnlein (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 122: 437-48(Nov. 1963). (In German) (KFK-195)

Electron spin resonance spectra of nucleic acid bases were investigated. Yields of unpaired spins per unit dose absorbed show interesting analogies to radiobiological results obtained in living materials. (auth)

31237 UNIVERSAL TOLERANCE TO HOMOLOGOUS TISSUE IN ADULT MICE PROTECTED FROM LETHAL IRRADIATION BY HOMOLOGOUS NEWBORN LIVER. Waid Rogers and J. Bradley Aust (Univ. of Minnesota, Minneapolis). Surg. Forum, 13: 87-8(1962).

Persistence of homologous skin grafts on lethally irradiated mice protected with homologous newborn liver from an animal unrelated to either the skin donor or the recipient is demonstrated. Full-thickness homologous skin grafts were sutured on backs of adult mice. The following day recipients were irradiated with 700 r total-body irradiation. Within 24 hr newborn liver suspensions of 2×10^6 cells were injected into the tail vein. Strepto-

mycin (0.6 mg) was given subcutaneously daily for 10 days. Grafts were observed for luxuriant hair growth as the criteria for take, and development of skrinkage or scaliness was counted as rejection even in the presence of hair. When C3H recipients were injected with liver from newborn C56BL mice and grafted with skin from strain A, C3H, or C57BL mice, the results showed 65% of surviving mice tolerating grafts 30 days and 30% for 50 days. Mice protected with isologous spleen rejected homologous grafts. Fetal or newborn tissue is superior in decreasing the subsequent mortality of the graft-vs-host reaction. (BBB)

31238 THE RELATIONSHIP BETWEEN RADIATION INJURY TO THE SKIN AND SUBSEQUENT MALIGNANT CHANGE. Z. Neuman, N. Ben-Hur, and J. Shulman (Rothschild Hadassah Univ. Hospital, Jerusalem). Surg. Gynecol. Obstet., 117: 559-62(1963).

Eighty-five patients with radiation injury are presented. Forty-five had radiation for malignant conditions, and basal cell carcinoma developed in only two. Forty had radiation for benign conditions and carcinoma developed in 13 of these. Patients who had long, so-called conservative treatment showed transitional forms of basosquamous cell, and finally squamous cell, carcinoma. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31239 SEVEN YEARS' EXPERIENCE WITH IRRADIATED BONE GRAFT MATERIAL. Alfred B. Swanson, James R. Glessner, Jr., Harry W. Burdick, and Robert C. Mahaney (Blodgett Memorial Hospital, Grand Rapids, Mich.). Surg. Gynecol. Obstet., 117: 573-7(Nov. 1963).

Management of a bone bank, with use of frozen homografts sterilized by high-speed electrons, and clinical observations are discussed. The bone, obtained at amputations, is passed beneath the Van de Graaff electron beam on a conveyor belt for irradiation on both sides and is given a total dose of 2 Mrep. The bone is packed in dry ice during irradiation to lessen the possibility of tissue destruction by the electron beam, and afterward stored at −20°C. Irradiated homografts were used for various procedures: for 216 spinal fusions, in scoliosis, spondylolisthesis, and tuberculosis; 37 arthrodeses, 20 osteotomies; 12 bone blocks; 9 nonunions (in which the procedures were not helpful); 12 fresh fractures; 19 cysts and tumors; fill-in of 10 donor sites; 36 sternotomy closures, and 6 miscellaneous conditions, for a total of 368 procedures. It is recommended that bank bone should not be used in major nonunions when there is any possibility of using an autogenous graft. The over-all infection rate in the series was 1.9%. Results proved the irradiated homograft to be an excellent adjunct in bone graft surgery, when homogenous bone is indicated. (BBB)

31240 PAPER-STRIP ELECTROPHORESIS STUDIES OF POST-IRRADIATION CHANGES IN γ-IRRADIATED OVALBUMIN. Charles A. Leone and Kenneth W. Perry, Jr. (Univ. of Kansas, Lawrence). Trans. Kansas Acad. Sci., 66: 202-12(1963).

Irradiation of ovalbumin by γ-rays caused the production of modified molecules of protein that, during paper-strip electrophoresis, did not migrate as far as native protein. Lyophilized ovalbumin, irradiated and stored under vacuum at 0° to 5°C, retained modified and characteristic electrophoretic patterns for a period of nine months and was considered stable; post-irradiation changes occurred after the protein was exposed to cold air in the refrigerator. Irradiated solutions likewise were electrophoretically characteristic and stable until they were exposed to air. In the solutions made up from lyophilized, irradiated protein and in the irradiated solutions additional losses of native-like protein were observed as the systems aged. In some solutions the amount of native-like protein first decreased and then, after several months, increased indicating that restorative changes can occur. (auth)

31241 THE EFFECT OF ULTRAVIOLET RADIATION ON THE ULTRASTRUCTURES OF THE CELL. V. F. Mashanskii and K. A. Samoylova (Inst. of Cytology, Academy of Sciences, USSR). Tsitologiya, 6: 59-65(1964).

Results are reported from a series of studies on the effects of 2537 Å monochromatic ultraviolet radiation on the microstructure and metabolism in Paramecium caudatum at various stages in the growth cycle. Emphasis was placed on changes induced in mitochondria during the first few hours after irradiation. A swelling of the mitochondria and a sharp decrease of the electron density of the matrix were attributed to a radioinduced increase of mitochondrial activity. An increase in the uv dose caused the swelling to decrease and it was not noticeable after irreversible damage was achieved. Twenty-four hr after irradiation, destruction of the interior mitochondrial membranes was observed. It was concluded that certain components of the respiratory chain were affected at the time of irradiation and that mitochondria are the most uv-sensitive part of the cell. (TCO)

31242 A THEORETICAL MODEL FOR THE STUDY OF THE EFFECTS OF NEUTRONS AND X RAYS ON TUMOR CELL POPULATIONS. Giovanni Silini and Rupert G. Miller (Centro Studi Nucleari della Casaccia, Rome and Stanford Univ., Palo Alto, Calif.). Tumori, 50: 13-24 (Jan.-Feb. 1964). (In Italian)

Data obtained in earlier experiments on Ehrlich ascites tumor cells irradiated with fast (6-Mev) neutrons and 200-kv x rays were used as the basis of mathematical formulation of a model describing the effect of such ionizing radiations on tumor cell population, the end-effect being the inhibition of reproductive integrity. The variables considered in this model are largely based on the above original work performed on transplantable tumors and from other published data; and deal with: the sensitivity of the tumor cell population with respect both to the extrapolated number of survivors and to the slope of the exponential part of the survival curve; the type of radiation used, allowing for different RBE values under oxygenated or anoxic conditions; the oxygen-enhancement ratios of the radiations considered; different modes of irradiation (single and multiple doses), allowing for cell recovery in the latter case; different means of fractionation with respect to the magnitude of the dose delivered at each fraction; the degree of anoxia and the percentage of anoxic cells in the tumor population; and possible variations in the percentage of anoxic cells at various points along the course of the radiation treatment. The results of the theoretical analysis are presented, both with regard to the shape of the survival curve of the total cell population and to dose-cure-rate tables, under each of the above-mentioned conditions. The possible advantages and limitations of the use of neutrons in clinical radiotherapy are also considered, and it is concluded that neutrons might be of particular value for irradiation of necrotic or relatively avascular tumor tissue. (BBB)

31243 THE RADIOSENSITIVITY OF SOMATIC MUTATIONS IN TROPICAL PLANTS. Robin L. Cuany and Luis E. Guardia (Istituto Interamericano de Ciencias Agricolas Turrialba, Costa Rica). Turrialba, 12: 146-50 (July-Sept. 1962). (In Spanish)

Chronic irradiation at the Turrialba gamma field shows

that, of four kind of palms, Guilielma grows vigorously at 250 r/day, but Cocos dies at 150 r/day. Maximum doses for survival of Areca catechu is 150 r/day, while Elaeis has a normal appearance at this exposure, although it is not as resistant to radiation as Guilielma. The LD_{50} of banana stems is around 20 Kr. Pinus caribaea and P. halepensis grow normally with up to 16.2 r/day, but P. montezumae is found alive and green at 26 r/day (seven months exposure). Propagating stems of Panicum maximum budded more easily after moderate doses of chronic gamma irradiation. (auth)

31244 METABOLISM OF HUMAN ERYTHROCYTES AFTER TREATMENT WITH X-RAYS. K.-U. Blum and E.-D. Voigt. Verhandl. Deut. Ges. Inn. Med., 69: 200-2 (1963). (In German)

In order to show that investigations that measure several reaction stages simultaneously have only a limited utility, the metabolism of isolated human erythrocytes was studied after exposure to x-ray doses of 800 r. The lactic acid production, oxygen consumption, and activity of glycerine aldehydephosphate dehydrogenase (GAPDH) and glucose-6-phosphate dehydrogenase were the factors measured. The results showed that the lack of variations in the balance-sheet investigations of entire reactions do not permit the assumption that all individual stages are unaltered. Although the lactate production and the oxygen consumption in the presence of methylene blue remained the same after irradiation, the activity of the enzymes GAPDH and G-6-PDH increased. The determinable increase of the enzyme activity is dependent in its extent on the time point of the investigation. (J.S.R.)

31245 PRE-SOWING GAMMA-RADIATION RAISES SMUT-RESISTANCE OF WHEAT. M. M. Tsymbal and V. A. Chizh. Vestn. Sel'shokhoz. Nauki, Vses. Akad. Sel'shokhoz., No. 6, 55-7(1963). (In Russian)

Odesskaya three winter wheat seed was radiated under laboratory conditions, at room temperature, the moisture content of radiated seed being 12 to 13 per cent KC-2A-50 radiator was used without filter, the seed being placed at the distance of 50 cm from the source of radiation. The seed was radiated with Co isotope at 1200 to 2500 r. The radiated seed was sown for two years on two different dates on the experimental field of the Sinelnikovo Plant Breeding Experiment Station. Radiation increased resistance of wheat to covered smut. Preliminary experiments show that radiation favorably affects the development and growth of crops in most variations; radiation at the above rates increased the absolute weight (weight of 1000 grains) of wheat. It was also found that the resistance of winter wheat to covered smut induced by Co radiation is transmitted to progeny by heredity. Radiation preserved seed from molding caused by specific fungi. (auth)

31246 INFLUENCE OF X-RAY IRRADIATION ON GLUTATHIONE CONTENT AND DEHYDROGENASE ACTIVITY. L. K. Finagin. Visn. Kiives'k. Univ., No. 4, Ser. Biol. No. 1, 120-3(1961). (In Russian)

Young male guinea pigs given 500 r irradiation and killed at 2 hrs, 3, 5, 7, or 10 days postirradiation were used to study effects of radiation on liver and muscle dehydrogenase activity and on blood glutathione content. Dehydrogenase activity was characterized by an initial fall, followed by a rise, and again falling in the final phases of radiation sickness. Activity of glutathione in the blood and muscles was initially raised and then fell, whereas in the liver the converse was noted. (H.M.G.)

31247 CHOLESTEROL METABOLISM IN DIFFERENT PERIODS OF RADIATION SICKNESS. E. F. Sopin. Visn. Kiivs'k. Univ., No. 5, Ser. Biol. No. 2, 129-34(1962). (In Russian)

Cholesterol metabolism in the liver, brain, and muscles of guinea pigs irradiated with 600 r was studied using $^{14}CH_3COOH$. A reduced amount of cholesterol and intense restoration process which levels off with the increase of cholesterol was observed during the first day following the exposure. An identical situation was observed the first and third day in the liver. In the brain the resoration intensity was reduced from the very first day. The amount of the cholesterol increased at the fifth day with the tendency of decreasing, however, remaining above normal on the tenth day after the exposure. (R.V.J.)

31248 EFFECT OF X-RAY IRRADIATION ON OXYGEN UPTAKE BY PLANARIANS. Clyde M. Senger (Montana State Univ., Missoula). Worm Runner's Dig., 6: 46-51(Mar. 1964).

Radiation effects on oxygen uptake by planaria was studied as a method of detecting radiation damage in the supralethal dose range. Oxygen uptake in microliters was determined in Dugesia dorotocephala x irradiated with 5000 and 10,000 rads, doses known to be well above the LD_{50} for the organism. Uptake was consistent for the first seven hours, but declined considerably from the initial rate during the following 15 hours. Data from the experiment did not warrant the conclusion that there is a change in oxygen uptake following irradiation of planarians. It is suggested that should radioinduced changes in oxygen uptake occur, more replications and perhaps consideration of dry mass would be necessary for demonstration of the phenomenon. (H.M.G.)

31249 PROJECT GLOWWORM RIDES AGAIN. Harold T. Salive and Margaret L. Clay (Univ. of Michigan, Ann Arbor). Worm Runner's Dig., 6: 78-81(Mar. 1964).

The hypothesis that some planarian species can survive very large cumulative doses of irradiation through use of their excellent regenerative abilities was investigated in flatworms receiving various chronic doses. Fifty-two week cumulative doses were administered six groups of animals by giving weekly doses of: 0, 200, 250, 300, 350, and 400 r. Beyond the 200 r level the higher the chronic dose, the fewer animals survived. Effects of cumulative dosage were also measured by observation of variations in replication by fission (tail dropping) for the different dose levels. Taildrops in the 400 r/wk group appeared to be highly radioresistant. No mutations were discernible in taildrop or original worms. (H.M.G.)

31250 PRELIMINARY EXPERIMENTS ON THE STERILIZATION OF THE PUPAE OF THE KHAPRA BEETLE BY IRRADIATION WITH GAMMA RAYS. I. Akif Kansu (Ankara Univ.). Z. Angew Entomol., 49: 224-8 (1962).

The effect of single doses of gamma irradiation delivered to the pupae of Trogoderma granarium Everts is described. It was found that, 6000 r or higher dosages reduced the reproductive capacity of the species when delivered on the male papae. The highest dosage of 15,000 r applied was sufficient to sterilize all the males. For the female pupae, a dosage of 7500 r was seemingly insufficient as no effect on the reproductive capacity was observed. The effect of irradiation as described in this work was more apparent in the second generation than in the first. Some adults with malformed elytra was observed to emerge when a dosage of over 10,000 r was applied. (auth)

31251 MALFORMATION AND REGENERATION OF THE MAMMALIAN RETINA FOLLOWING EXPERIMENTAL RADIATION. Samuel P. Hicks and Constance J. D'Amato.

p.45-51 of "Les Phakomatoses Cerebrales, Deuxieme Colloque International, Malformations Congenitales de L'Encephale." L. Michaux and M. Feld, eds. Paris, S.P.E.I., 1963.

Pregnant rats were exposed to doses of 150 to 200 r x radiation on specific days after coitus and some of the embryos and fetuses were removed at various time intervals. The abnormal and normal development of the nervous system was studied at a histogenetic level in the offspring of irradiated and control animals from the 12th fetal day to the 10th postnatal day. Preliminary results are reported from a study of the sequence of events leading to malformation or restitution of the retina. A timetable is presented for radioinduced malformations caused by 150 to 200 r x radiation in the rat. (C.H.)

31252 EFFECTS OF SMALL DOSES OF X RADIATION ON THE PROCESS OF INCUBATION OF CHICKEN EGGS. S. A. Dzhabieva. p.68-73 of "Voprosy Fiziologii. Tom III." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1960. (In Azerbaijan)

Experiments showed that x irradiation of eggs in doses of 1 to 30 r has a definite influence on the development of the embryo. Hatchings from irradiated eggs are 6.4 to 10.3% higher than those from nonirradiated eggs. In the first 20 days, the live weight of experimental and control chicks was nearly the same. After a longer time, nearly three months, the weight of the controls somewhat surpassed that of the experimental chicks. A simultaneous study was made of the deaths of chicks in the experimental and control groups. In the course of months 2.2% more died in the experimental than in the control group. (M.J.T.)

31253 THE EFFECT OF X RAYS ON THE UNCONDITIONED INTEROCEPTIVE EXCHANGE REFLEXES. A. I. Karaev and S. A. Dzhabieva. p.38-43 of "Voprosy Fiziologii. Tom IV." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1960. (In Azerbaijan)

The effect of x irradiation on the magnitude and character of the unconditioned interoceptive exchange reflexes was studied. The change of blood sugar levels upon stimulation of the receptors of the rectum was studied in 10 rabbits before and after x irradiation. The interoceptive exchange reflexes were studied at 1, 5, 10, 20, and 30 days after irradiation. It was concluded that irradiation by fractionated doses of 10 r during 30 days first increases and then depresses the reflexes; a single 300 r dose reduces the reflexes. (M.J.T.)

31254 THE CHANGE OF ELECTRICAL ACTIVITY OF THE CORTEX AND OF RETICULAR FORMATIONS IN VARIOUS REGIONS OF THE BRAIN UPON STIMULATION OF EXTEROCEPTORS AND INTEROCEPTORS IN ANIMALS IRRADIATED BY X RAYS. N. A. Mushkina. p.74-93 of "Voprosy Fiziologii. Tom V." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1962. (In Russian)

Experiments showed that total single x-ray doses of 300 and 500 r to rabbits produced changes in the character of the cortex electrical activity and of the specific and nonspecific subcortical formations. Electroencephalographic analysis indicated a decrease in the functional level of the cortex and subcortical formations; this decrease was demonstrated by the limitation of the ability of the cortex and reticular formations to reproduce the rhythm of light flashes and by the depression and distortion of the character of the reaction of the nerve formation to continuous-light, sound, and interoceptive stimulations of the stomach and rectum. It was found that small x-ray doses—50 and 100 r—and chronic 50 and 100 r doses produced less pronounced and less lasting changes in the cortex electrical activity and the subcortical formations and a faster return to a normal reaction to extero- and interoceptive stimulations. However, with chronic irradiation, a gradual increase of the total dose produced increased functional instability in the reaction to stimuli. (M.J.T.)

31255 EFFECT OF SMALL X-RADIATION DOSES ON THE PROCESS OF INCUBATION OF CHICKEN EGGS (REPORT II). S. A. Dzhabieva. p.94-100 of "Voprosy Fiziologii. Tom V." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1962. (In Azerbaijan)

An attempt is made to increase the previously-measured increase in hatched chicken eggs after x irradiation, by determining the effect after doses of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, and 30 r. Hatchings from irradiated eggs were 7 to 10% higher than from nonirradiated ones. (M.J.T.)

31256 THE ACTION OF SMALL DOSES OF RADIOACTIVE PHOSPHORUS ON THE PROCESS OF DEVELOPMENT OF CHICKEN EMBRYOS. S. A. Dzhabieva and T. A. Agadzhanova. p.30-5 of "Voprosy Fiziologii. Tom VI." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1963. (In Russian)

From results of experiments, it is concluded that beta irradiation of chicken eggs with radioactive phosphorus in doses from 10 to 50 r increases the percent of hatchings and shortens the length of embryo development. No deleterious effects from the irradiation were observed in the hatched chicks. (M.J.T.)

31257 THE CHANGE OF ELECTRICAL ACTIVITY OF THE CORTEX AND SOME SPECIFIC AND RETICULAR FORMATIONS IN VARIOUS REGIONS OF THE BRAIN UPON STIMULATION OF EXTERO- AND INTEROCEPTORS IN RABBITS IRRADIATED WITH X RAYS (SECOND REPORT). N. A. Mushkina and T. S. Kasimova. p.52-71 of "Voprosy Fiziologii. Tom VI." Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1963. (In Russian)

X irradiation of rabbits with a single 1000-r dose produced a strong reduction of cortical function. The reduction was shown by the fall of cortex excitability and lability in relation to various extero- and interoceptive stimulations and by the fast entrance after extero- and interoceptive stimulation into the condition of unlimited inhibition. The subcortical visual and auditory centers were affected less severely. The pathological condition of unlimited inhibition of nerve formation was demonstrated. Upon x irradiation of rabbits with 100 to 500 r or upon chronic weekly irradiation with a 100-r dose, up to a total of 1000 r, the gradual development of radiation disease led in the first period to an increase of excitability and lability both of the cortex and of the subcortical visual centers. In the second period of radiation disease, both the excitability and lability of the cortex and subcortical visual centers were depressed in relation to the increasing sickness. (M.J.T.)

31258 CONDITIONS AFFECTING THE EARLY THYMINELESS DEATH OCCURRING AFTER ULTRAVIOLET IRRADIATION OF ESCHERICHIA COLI B3. Robert B. Painter and Ronald E. Rasmussen (Ames Research Center, Moffett Field, Calif.). 14p. (CONF-534-2)

From Biophysical Society, 8th Annual Meeting, Chicago, Feb. 1964.

Exposure of the thymine-requiring bacterium Escherichia coli strain B3 to uv light prior to incubation in the absence of thymine shortens the lag period normally ob-

served before the onset of death due to lack of thymine. Culture conditions promoting Messenger RNA synthesis at the time of thymineless challenge after uv irradiation enhance this effect. The effect can be reversed either by the addition of thymine or photoreactivation. It is concluded that the principal uv photoproduct involved is probably thymine dimer, and the complementary action sites of uv light and thymineless ness in double stranded DNA combine to block DNA synthesis and to interfere with Messenger RNA synthesis at that point. (auth)

Radiation Effects Therapy and Countermeasures

31259 (AD-427279) EVALUATION OF RADIOPROTECTIVE AGENTS. Annual Progress Report, August 1, 1962–July 31, 1963. John B. Storer (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Contract DA-49-193-MD-2289. 13p.

Results are reported from a study to determine whether standard radioprotective agents (β-mercaptoethylamine, p-aminopropiophenone, 2-aminoethylisothiuronium bromide, and serotonin) will protect mice against the late deleterious effect of x-ray exposure. A total of 7200 treated and control mice were exposed to four dosage levels of x rays and set aside for longevity and histopathology studies. Both sexes from strains A/J and C57BL/6J were included. Seven radioprotective agents provided by the Walter Reed Army Institute for Research were evaluated in terms of chemical toxicity and radioprotective effect. The ratios of x ray LD_{50} values for treated mice to the control LD_{50} values ranged from 1.2 to 1.6. The comparable values for the standard agents listed above were 1.5 and 1.8. (auth)

31260 (NP-14045) GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES, AND RELATED SUBSTANCES, AS SOURCES OF ANTI-RADIATION DRUGS. Interim Research Report No. 18, January 1, 1964–March 31, 1964. R. B. Barbee, J. D. Buckman, H. K. Kim, W. B. Lacefield, and T. F. Parsons (Vanderbilt Univ., Nashville). Contract DA-49-193-MD-2030. 28p.

Progress is reported in the synthesis of organic sulfur compounds for testing as radioprotective compounds. Four compounds were submitted for screening. p-Tolyl trithiopercarbamate was synthesized. The symmetrical trisulfide resulted when an attempt was made to prepare the 2-acetamidoethyl analog in water. The p-tolyl ester disproportionates readily to p-tolyl trisulfide. Results with both the p-tolyl and acetamidoethyl compounds suggest that trisulfides might be made effectively in this way and may be potential anti-radiation drugs. Studies on the preparation of mercaptodisulfide, analogs of o-2-aminoethyldithiobenzoic acid, and the synthesis of unsymmetrical disulfides containing a trichloromethyl group were continued and one dithiosulfite, $(tert\text{-}C_4H_9S)_2SO$ was synthesized. The chemistry of this compound was studied to provide hints as to how other dithiosulfites possibly might be obtained. Pyrolysis of the tert-butyl ester evidently gives one-half molar proportion of sulfur dioxide, of di-tert-butyl disulfide, and of di-tert-butyl trisulfide. This ester does not react with acetic acid or neutral thiol, and only slowly with pyridine. The corresponding diisopropyl ester decomposed overnight, and the n-butyl ester could not be obtained at all. These esters appeared to behave like the tert-butyl in giving sulfur dioxide, a disulfide, and a trisulfide, except that decomposition was much more rapid. 2-Aminoethyl-2,4,6-triisopropylphenyl disulfide was obtained. Its disproportionation was slow, but evidently for electronic rather than steric reasons. Studies were completed of the disproportionation of substances of the formula $p\text{-}XC_6H_4SS(CH_2)_2NH_3Cl$. Photochemical disproportionation did not follow the same substituent order as thermal disproportionation. Evidence is presented that the photochemical process involves radicals and that the thermal process is essentially an ionic heterolytic one. Similar studies are reported for the ortho series. (auth)

31261 (JPRS-25350) CERTAIN PROBLEMS OF BONE MARROW TRANSPLANTATION IN RADIATION AFFECTIONS. K. K. Zaytseva. Translated from Arkh. Patol., 26: No. 3, 3-15(1964). 21p. (TT-64-31623)

Data are reviewed from a number of experimental and clinical studies on reactions to bone marrow transplants. Emphasis is placed on applications of bone marrow transplants in the treatment of radiation injuries; immune reactions to transplanted homologous and heterologous hematopoietic tissue; the symptoms of secondary disease; the effects of irradiation dose, mode of administration, number and character of the marrow cells introduced, and the species of the experimental animal on response to transplanted bone marrow; various methods used to reduce the number of immunologically competent cells in donor marrow to reduce the frequency of secondary disease; and methods for the preservation and evaluation of viable marrow cells. (C.H.)

31262 (JPRS-25251) THE STATE OF HEMOPOIETIC TISSUE IN ACUTE RADIATION SICKNESS UNDER CONDITIONS OF BONE MARROW TRANSPLANTATION. N. S. Rozanova, V. N. Malanina, G. V. Sukyasyan, and M. N. Novikova. Translated from Arkh. Patol., 26: No. 4, 32-40 (1964). 15p. (TT-64-31556)

The intravenous or intraosseous administration of bone marrow did not prevent the development of acute radiation sickness in dogs x irradiated with a minimal lethal dose (LD_{95}), but eased its course in the early stages of the disease, increased survival rate, and provided the possibility of hemopoietic regeneration. In late periods of the disease, the process of restoration of hemopoiesis in animals that have been irradiated with a lethal dose of radiation (LD_{95}) and treated by the administration of bone marrow follows the same course of reticular hyperplasia as in radiation sickness that has not been treated with bone marrow. Lymphopoiesis was not restored during the whole period of observation (190 days after irradiation). Changes developing in the spleen in the first days after irradiation increased progressively during the whole period of observation and led to a well marked fibrosis of the splenic pulp. In the late periods of examination (153 to 190 days), a secondary, considerable reduction in the mass of myeloid tissue was noted with adipose tissue replacing the myeloid in the presence of a normal ratio of cellular elements in the hemogram and myelogram. Suppression of the restoration process was possible in the phase of reticular hyperplasia with a disturbance in the process of further differentiation of the cellular elements and with the development of changes that are characteristic of preleukemic states. (auth)

31263 RADIOPROTECTIVE EFFICACY OF CYSTEAMINE. A. Bose, S. Bose, and P. De (National Cancer Research Center, Calcutta). Acta Radiol. (N.S.), 2: 109-12(Apr. 1964).

A study of the efficacy of 150 mg/kg bodyweight cysteamine in modifying the effects of whole-body radiation doses ranging from 400 to 800 r is reported. The mitotic

index of rat bone marrow cells was used as the biologic reference system. The conclusion is reached that the efficacy of cysteamine is inversely proportional to the radiation dosage. (auth)

31264 ALKOXYGLYCEROLS AND THEIR USE IN RADIATION TREATMENT. AN EXPERIMENTAL AND CLINICAL STUDY. A. Brohult. Acta Radiol., Suppl. 223, 99p. (1963).

Alkoxyglycerols prevent, to a certain extent, leuko- and thrombocytopenia. This effect has been demonstrated in two ways: The decrease in white cells and thrombocytes which usually occurs during radiation treatment is less pronounced if alkoxyglycerols are administered during this treatment. If the white cell or thrombocyte count is already low due to irradiation or to some therapeutic chemicals, it has been possible to increase the number of these cells by the administration of alkoxyglycerols. In experiments with irradiated rats, it has been shown that the alkoxyglycerols or their esters inhibit, to a certain extent, the decrease of both megacaryocytes and nucleated cells in the bone marrow, which usually occurs after irradiation. The decrease of megacaryocytes is prevented more by selachyl alcohol than by batyl alcohol. Both for the free alcohols and for the esters, the effect was found to be related to the quantity administered; it decreased above an optimal dosage. Alkoxyglycerols not only have an effect on the bone marrow, they also influence the growth of rats. When irradiated rats were prophylactically treated with alkoxyglycerols the increase in weight was higher than for the irradiated control group, which received no such treatment. As in the case of the megacaryocytes, the increase in weight was found to be related to the quantity administered and decreased above an optimal dosage. Batyl alcohol has a greater effect on the growth of rats than does selachyl alcohol. The damage caused by radiomimetics is also counterbalanced to some extent by alkoxyglycerols. Alkoxyglycerols promote the growth of L. Lactis. The growth-promoting effect on L. Lactis is greatest for batyl alcohol, followed by selachyl alcohol and chimyl alcohol. The survival times for a group of 350 patients suffering from cancer of the uterine cervix increase with the total amount of alkoxyglycerols administered during the radiation treatment. The increase is observed for both 1- and 5-yr survivals. (Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964)).

31265 THE EFFECT OF X-RAYS ON THE CATALASE ACTIVITY. I. THE ACTIVITY OF RED BLOOD CELL CATALASE IN THE EXPERIMENTAL POST-RADIATION DISEASE OF RABBITS. Gerard Jonderko and Stanislaw Kośmider. Arch. Immunol. i Terapii Doswiadczalnej, 8: 519-23(1960). (In Polish)

The experiments were carried out with three groups of rabbits, five animals in each. The animals from the first group received 500 r, from the second –700 r and those from the third one–1000 r. The catalase activity was determined at some days' intervals. It was concluded that: the determination of the catalase activity for the evaluation of post-radiation effect is of value only immediately after radiation, and the activity of red cell catalase has no prognostic significance in post-radiation disease. (auth)

31266 ELECTROCARDIOGRAPHIC STUDIES IN POST-RADIATION DISEASE OF RABBITS. Stanisław Kośmider and Tadeusz Petelenz. Arch. Immunol. i Terapii Doswiadczalnej, 8: 537-49(1960). (In Polish)

Electrocardiographic studies were made in rabbits irradiated with x ray doses of 200 to 1000 r. Electrocardiographic changes brought about by x-rays were suggestive of the myocardial injury. No close correlation could be established between the x-ray doses and the intensity of electrocardiographic changes. Similar curves were obtained both with 200 and 1000 r doses. The differences in electrocardiographic patterns of particular rabbits apparently depend on individual sensitivity to x-rays. ECG changes in post-radiation disease showed a biphasic character; they occur immediately after irradiation and at the peak of postradiation disease. (auth)

31267 ELECTROPHORETIC STUDIES OF SERUM PROTEINS IN RABBITS WITH POST-RADIATION DISEASE. Stanisław Kośmider, Bolesław Piekarski, Tadeusz Petelena, and Lech Wierny. Arch. Immunol. i Terapii Doswiadczalnej, 8: 747-57(1960). (In Polish)

Changes, occurring in the serum protein pattern of rabbits after total, single irradiation were found to depend on irradiation doses and individual sensitivity of animals. After a dose of 200 r the albumin-globulin coefficient is shifted toward albumins; with higher irradiation doses, toward globulins. Animals under observation showed a reduction in the total amount of protein immediately after irradiation and its increase in the course of the disease. The observed increase in the globulin level in the course of postradiation disease, particularly in γ and to a less degree in α_1 and β fractions, is undoubtedly influenced by the development of secondary infection. (auth)

31268 RADIOMETRIC QUANTITATION OF THE INHIBITION OF 5-HYDROXYTRYPTAMINE-INDUCED EDEMA IN MICE. Eugene E. Vogin and G. Victor Rossi (Philadelphia Coll. of Pharmacy and Science). Arch. Intern. Pharmacodyn., 144: 151-60(July 1, 1963).

A new method was developed for the quantitation of localized edema which reflected more directly experimentally-induced fluid redistribution, and which appeared adaptable as a sensitive assay for anti-inflammatory drugs. Radioiodinated (^{131}I) serum albumin was used to trace the extent of plasma protein transudation induced by the injection of 5-hydroxytryptamine (5-HT) in the mouse paw. The following compounds were assayed with respect to inhibition of 5-HT-induced edema: sodium salicylate, acetylsalicylic acid, phenylbutazone, cyproheptadine hydrochloride, ascorbic acid, and hesperidin methyl chalcone. Various doses of these compounds were administered orally at various intervals preceding injection of 5-HT. Dose-response relations showed that sodium salicylate, acetylsalicylic acid, phenylbutazone, and cyproheptadine hydrochloride, administered orally, significantly reduce the edematous response to 5-HT, and that ascorbic acid, hesperidin methyl chalcone, and combinations of these compounds, do not significantly inhibit the inflammatory reaction. Evaluation of the results indicated that the radiometric tracer method for the determination of 5-HT-induced edema in the mouse paw constituted a convenient, reproducible, and relatively sensitive assay procedure for quantitation of the potential anti-inflammatory activity of nonsteroid compounds. (BBB)

31269 RESEARCH ON THE RADIOPROTECTIVE EFFECT OF MESO-2,3-DIMERCAPTOSUCCINIC ACID (DTS, DMS, Ro 1-7977). F. Cugurra and E. Balestra (Universitâ, Genoa). Arch. Ital. Sci. Farmacol., 11: 122-7(Apr. 1961). (In Italian)

Guinea pigs exposed to 300 r whole-body x radiation were protected from radiation injury by a dose of 10 mg/kg of 2,3-dimercaptosuccinic acid given immediately after radiation exposure. Less protection was afforded at higher radiation doses. (C.H.)

31270 RADIOPROTECTIVE EFFECT OF AN ISOMER OF 2,3-DIMERCAPTOSUCCINIC ACID. F. Cugurra and E. Balestra (Università, Genoa). Arch. Ital. Sci. Farmacol., 11: 238-43(July 1961). (In Italian)

A comparison was made of the radioprotective effects of meso-2,3-dimercaptosuccinic acid and its isomer d,l-meso-2,3-dimercaptosuccinic acid afforded more protection to guinea pigs exposed at the mid-lethal x-radiation dose range than did the isomer. However, for radiation doses above this range, the isomer d,l was more effective. Differences in the pharmacological action of the two substances having the same formula are discussed. (C.H.)

31271 PRELIMINARY RESEARCH OF RADIOPROTECTIVE ACTIVITY IN MICE OF AN ISOMER OF DITHIOSUCCINIC ACID. F. Cugurra and E. Balestra (Università, Genoa). Arch. Ital. Sci. Farmacol., 12: 218-23(1962). (In Italian)

2,3-Dimercaptosuccinic acid protected mice against a single skin dose of 400 to 700 r x radiation. An analogous action was shown by the two isomers of the compound. (C.H.)

31272 THE ACRIDINE ORANGE VIABILITY TEST APPLIED TO BONE MARROW CELLS. I. CORRELATION WITH TRYPAN BLUE AND EOSIN DYE EXCLUSION AND TISSUE CULTURE TRANSFORMATION. William E. Hathaway, Louis A. Newby, and John H. Githens (Univ. of Kentucky, Lexington). Blood, 23: 517-25(Apr. 1964).

Suspensions of murine bone marrow cells were stained with acridine orange (A-O) and observed under fluorescent microscopy after treatment with various injurious agents in order to establish the staining characteristics of live and dead cells. The percentage of viable cells demonstrated by the A-O viability test were correlated with eosin and trypan blue dye exclusion and tissue culture transformation viability tests. In general, the A-O test demonstrated the viability of cells preserved by freezing as effectively as the other in vitro tests. In addition, the A-O test may be more sensitive in determining the viability of cells where metabolic processes were injured by poisons or change in pH. (auth)

31273 CHEMICAL PROTECTION AGAINST RADIATION INJURY. I. AN EXPERIMENTAL STUDY OF CHEMICAL COMPOUNDS AS PROTECTIVE AGENTS AGAINST RADIATION INJURY. Susumu Izumi, Ryo Katsuhara, and Masayuki (Ground Self-Defense Force, Tokyo). Boei Eisei, 10: 474-8(Oct. 1963). (In Japanese)

Studies were conducted in mice exposed to whole-body sublethal, lethal, and supralethal doses of x rays to compare the protective effects of the following: S-2-aminoethylisothiuronium bromide hydrobromide (AET), 2-mercaptoethylguanidine (MEG), 3-mercaptopropylguanidine (MPG), uridine-5'-monophosphate (UMP), cytidine-5'-monophosphate (CMP), and vitamin B_6 (pyridoxal). Mice of the DD strain were irradiated with 60-kv x rays at a dose rate of 62 r/min to total doses of 680, 930, or 1100 r. The agents tested were injected 5 min before irradiation in doses ranging from 2 to 10 mg per animal. Protective effects of the six compounds against sublethal, lethal, and supralethal radiation doses are compared. Results obtained with these compounds were compared with those previously demonstrated with AET, MPG, and serotonin. (TCO)

31274 SEROTONIN AND LOCAL EFFECT OF X RAYS. 6. EXPERIMENTS WITH BUFOTENIN AND ISOSEROTONIN. A. Maggiora (Hôpital Cantonal, Geneva). Dermatologica, 126: 429-34(1963). (In French)

Guinea pigs locally irradiated with 800-r doses of 50-kv x rays and injected with the test compound 5 min before irradiation showed that 15-mg doses of serotonin creatinine sulfate prevented epilation in 27 out of 28 animals and 15 mg bufotenin oxalate in 5 out of 6 animals (transient epilation occurred in all uninjected guinea pigs). Similar protection was afforded by either drug injected 3 hr preirradiation but not by injections made 6 or 12 hr before or immediately after irradiation. In additional experiments with 1600-r doses a marked difference in the protective effect of the two compounds was noted: serotonin protected against persistent (but not transient) epilation, whereas bufotenin did not. Also, bufotenin, unlike serotonin, did not protect against lethal whole-body irradiation. Tests were also conducted on an isomer of serotonin, isoserotonin, which differs from serotonin in attachment of the side-chain amine at position 2 instead of 3 on the indole ring and in being less toxic. When tested with 800-r epilating doses in guinea pigs, isoserotonin, unlike serotonin, did not prevent temporary epilation, indicating that change in position of the aminoethyl group abolishes protective activity. (BBB)

31275 RESEARCH ON THE BIOLOGICAL PREVENTION OF ACUTE RADIATION DAMAGE. II. TRIALS OF ACTIVE AND PASSIVE IMMUNIZATION AGAINST THE EFFECTS OF TOTAL ACUTE IRRADIATION. C. Arghittu, L. Lenzerini, and M. Rossi-Torelli (C.A.M.E.N., Pisa, Italy). Igiene Mod. (Parma), 55: 615-27(Sept.-Oct. 1962). (In Italian)

The antigenic properties and the possibility of inducing active or passive immunization against radioinduced toxicity were studied in living tissues. A homogenate was prepared from various radiosensitive organs of rats x irradiated with 900 r and sacrificed seven days later. Thirty rats were injected with the antigen prepared from the homogenate; rabbits were similarly injected. Irradiation (750 r) was administered to rats treated with adsorbed radioantigen, and also on other lots treated with immune plasma, with normal plasma, and controls. Irradiations were also performed on rats treated with rabbit immune plasma and with rabbit normal plasma. Illustrations show reactions for various organs: strong antigen-antibody reaction between rat immune serum and normal organs, weak antigen-antibody reaction between immune serum and irradiated organs, strong antigen-antibody reaction between rabbit immune serum and normal rat organs, strong antigen-antibody reaction between rabbit immune serum and irradiated rat organs. Controls were negative. Rats treated with antigen and then irradiated died sooner than controls; those treated with rat immune plasma showed 48% survival at the 40th day; those with normal plasma, 45%; and controls, 13%. Animals treated with rabbit immune plasma had 40% survival in 40 days, with controls showing 13% survival. Groups treated with normal plasma had 100% mortality in 18 days. No conclusions about the existence of a radiotoxin were drawn. (BBB)

31276 THE ROLE OF CALCIUM COMPLEX FORMATION IN RADIOPROTECTION BY INORGANIC CONDENSED PHOSPHATES AND EDTA. J. H. Barnes and J. St. L. Philpot (Medical Research Council, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 7: 427-45(Nov. 1963).

The tetany and radioprotection resulting from intraperitoneal injection of inorganic condensed phosphates or EDTA in mice were abolished by addition of Ca. When tetany was abolished by mephenesin, reduction of radioprotection was significant only with open-chain phosphates and EDTA, not with cyclic metaphosphates. Complexing agents for cu-

prous and/or cupric ions showed no radioprotection. Orthophosphate, ammonium chloride, and Ca salts were also ineffective. Though adenosine triphosphate prolonged survival in anoxia the inorganic condensed phosphates did not. Thus their high-energy groups seem not to be biologically available. Radioprotection by condensed phosphates was only prophylactic, not curative. It was concluded that radioprotection by condensed phosphates and EDTA is due to Ca complex formation acting mainly via tetany with open-chain phosphates and EDTA and mainly otherwise with cyclic phosphates. Low ionic Ca may cause hypoxia via tetany or cardiac insufficiency. Thus hypoxia may account for radioprotection in all the above cases. (auth)

31277 STUDIES OF THE LSA ASCITES LYMPHOMA OF C57B1 MICE. II. RADIOSENSITIZATION IN VIVO WITH 5-BROMODEOXYCYTIDINE AND COMBINED 5-FLUORODEOXYURIDINE AND 5-BROMODEOXYCYTIDINE. Yosh Maruyama, Giovanni Silini, and Henry S. Kaplan (Stanford Univ., Palo Alto, Calif.). Intern. J. Radiation Biol., 7: 453-64(Nov. 1963).

Radiation dose-survival curves were obtained for the LSA ascites lymphoma of C57B1/Ka mice after administration of the halogenated thymidine analog BCDR, alone or in combination with FUDR. A 7% thymine replacement by BU has been obtained with BCDR-treatment alone with a sensitization factor relative to the saline-treated control of 1.7. A 14% thymine replacement was obtained with combined FUDR- and BCDR-treatment. The latter treatment was accompanied by a 9-fold increase in the TD50 and a 2.4 sensitization factor to x irradiation relative to the controls. (auth)

31278 THE RADIOPROTECTIVE ACTION OF A NUMBER OF CYSTEAMINE DERIVATIVES AND RELATED COMPOUNDS. D. W. van Bekkum and H. T. M. Nieuwerkerk (RVO-TNO, Rijswijk, Netherlands). Intern. J. Radiation Biol., 7: 473-47(Nov. 1963).

The protective action of a number of derivatives of cysteamine and of a series of mustard analogs against the lethal effects of whole-body x irradiation in mice is reported. The most effective derivatives found were 2-amino-1-propanethiol and 1-amino-2-propanethiol. The latter compound was found to possess a prophylactic range which is considerably larger than that of any of the other compounds of the cysteamine series, including AET and cysteamine itself. N- and S-substitution of the cysteamine molecule produced a decrease of protective activity. Most of the mustard analogs were highly toxic, and none was found to have more than a slight protective action. (auth)

31279 PROTECTION AGAINST ACTIONS OF X-RAYS BY GLYCEROL IN THE BACTERIAL SPORE. R. B. Webb and E. L. Powers (Argonne National Lab., Ill.). Intern. J. Radiation Biol., 7: 481-90(Nov. 1963).

The effect of glycerol on the three classes of radiation damage previously recognized in the spores of Bacillus megaterium was examined. Glycerol was found to reduce the amount of damage associated with each of the classes. The direct action component was almost certainly involved. It is the presence of glycerol rather than the absence of water that is responsible for the effect. The concentration-effect relation is described by the Langmuir adsorption equation, consistent with the notion that protective action is the consequence of physical adsorption on important sites as previously described for vegetative bacterial cells. Extrapolation of the Langmuir relation to infinite glycerol concentration gives a value of 0 for that portion of the damage unaffected by glycerol. The adsorption sites may be the same as those usually occupied by water. The results indicate also that spores and vegetative cells are affected by radiation in similar manners. (auth)

31280 EARLY POST-IRRADIATION REACTIONS AND THEIR MODIFICATION BY MEANS OF CHEMICALS. Antoni M. Dancewicz. Kosmos (Warsaw) Ser. A, No. 1, 23-31(1964).

The effects of ionizing radiation on living organism are reviewed. Neither the original target theory nor the theory of indirect effect is considered to have fully explained the mechanism of occurring biological reactions or the modifying effect of preventively administered chemicals. Studies established a priority of biochemical effects, which include changes in the activity and coordination of enzymes, enzymatic degradation of macromolecules and formation of atypical toxic substances in the cell, disorders in protein and DNA synthesis, blocking of oxidative phosphorylation (especially in cell nuclei), and inactivation of free SH groups. It was not clearly ascertained, however, if these are the only primary effects, whether they are interdependent, and which are responsible for later effects. Radiological chemistry research disclosed many substances that can alleviate the effects of radiation, but relatively few that can prevent them. These include lower-chain members of the cysteamine group (free SH and NH_2 radicals), some sulfhydryl isothiourea derivatives (free SH and guanadine), colloidal sulphur and some sulphur-containing organic compounds, as well as some pharmacological agents which inhibit metabolism, affect the central nervous system, or cause methemoglobinemia. However, even with the most effective agents (cysteamine, AET, serotonin, and some mixtures) the best result obtained was survival of animals after a 2 to 3 times medium lethal dose, and in vivo checks of the mechanism were not established. The mechanism may involve the inactivation of the radiolysis products, direct combination with cell or protein components (sulfhydryl to bisulphide), or reduction of oxygen to block the harmful radiation reaction. (OTS)

31281 RADIATION INJURY. THE ACUTE AND LATE EFFECTS. A PROBLEM IN INDUSTRIAL AND MILITARY MEDICINE. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Maryland State Med. J., 1-8(Aug. 1963). (BNL-6995)

The pathogenesis of the acute radiation syndrome is discussed along with the management of the hemopoietic phase of the radiation syndrome. The types of radiation accidents that have occurred to date in American, European, and Russian industrial establishments are described along with clinical summaries of the course and management. In addition, the late somatic effects of radiation, such as leukemia, cataracts, and the question of decreased longevity, are critically analyzed, In conclusion, the role of radiation injury in nuclear warfare and its magnitude and practical management are discussed. (auth)

31282 THE INFLUENCE OF MEXAMINE ON THE COURSE OF THE ORGANISMS GENERAL REACTION IN PATIENTS SUBJECTED TO RADIUM THERAPY. A. N. Gamaleya, M. D. Donskoi, and A. V. Surikov. Med. Radiol., 9: No. 5, 15-20(May 1964). (In Russian)

Data relevant to the use of mexamine (chloral hydrate-5-methoxytryptamine) during radium therapy of oncological patients for the purpose of eliminating or alleviating the supervening symptoms of general reaction of the organism to the radiation effect, as well as for its prevention are presented. Clinical investigations disclosed that the peroral use of mexamine in a dose of 0.05 20 to 30 minutes

before a seance of telegammatherapy completely eliminates in over 50 per cent of cases and in one-third of patients diminishes the manifestations of the general reaction. The radioprotection action of the preparation is more manifest in slightly pronounced symptoms of the general reaction and it is manifested to a lesser degree in a reaction of moderate severity. The shortcomings of mexamine are the untoward reactions observed in one-fifth of cases, which promptly disappear upon withdrawal of the preparation. Mexamine is a valuable agent for controlling the manifestations of the organism's general reaction during radium therapy. (auth)

31283 CHANGES OF THE FRACTIONAL COMPOSITION AND COLLOIDAL RESISTANCE OF RABBIT BLOOD SERUM PROTEINS IN RADIATION SICKNESS. Yu. M. Madievskii. Med. Radiol., 9: No. 5, 24-9(May 1964). (In Russian)

Under investigation were changes of the fractional composition and thermal resistance of the blood serum of rabbits during a period of two months following single total x-ray irradiation in doses of 200 and 800 r. The effect of irradiation is attended by quantitative and qualitative changes in the protein composition, the duration and markedness of which depends on the irradiation dose. Dynamic alterations of the fractional composition are of diverse nature in doses of 200 and 800 r. The degree and duration of heightened thermal resistance are in direct proportion to the dose of irradiation. Thermal resistance changes do not depend upon redistributions of the fractional composition in the blood serum protein complex. (auth)

31284 COMPENSATORY POSSIBILITIES OF THE LYMPHATIC SYSTEM IN ACUTE RADIATION SICKNESS. M. I. Aksyantsev, D. E. Goldshtein, and Ya. B. Mittelberg. Med. Radiol., 9: No. 5, 39-44(May 1964). (In Russian)

The possibility of development of collateral lymph circulation in experiments on dogs with acute radiation sickness was assessed. For this purpose the state of collateral lymph circulation of pelvic extremities in dogs was investigated by using an infectious stimulus (a culture of Staphylococcus aureus) and a mechanical stimulus (tourniquet) in acute radiation sickness, according to data of intravital lymphography. The state of the lymphatic system reflects the reactive capacity of the organism. The development of collaterals is not a factor of mechanical obstruction, but the organisms reaction to an infectious or mechanical stimulus. In acute radiation sickness the reaction of the organism in the presence of additional stimuli is of phasic nature. The development of collateral lymph circulation is revealed only during the first days of acute radiation sickness, before the breakdown of the organism's resistance. (auth)

31285 RADIOSENSITIVITY OF MICE FOLLOWING SPLENECTOMY AND THE USE OF SPLENIC TISSUE HOMOGENATE IN CHRONIC RADIATION SICKNESS. K. L. Kovalevskii. Med. Radiol., 9: No. 5, 58-62 (May 1964). (In Russian)

Leucocytosis was observed in mice after splenectomy. The leukocyte count decreases more sharply, and its restoration is delayed in splenectomized mice. Pathologico-anatomical studies revealed the hemorrhagic syndrome in splenectomized mice, whereas in control mice, there is seen hyperemia of internal organs. The course of radiation sickness is more severe and the lethality greater in splenectomized mice than in animals irradiated with the same x-ray doses, but with a preserved spleen. Upon the administration of splenic tissue homogenate to splenectomized animals, the lethality shows a decline during the first hours after x-ray irradiation. The splenic tissue homogenate prevents the development of multiple hemorrhages into the internal organs in irradiated mice. (auth)

31286 METHIONINE AND HOMOCYSTEINE AS PROTECTIVE AGENTS AGAINST IRRADIATION DAMAGE. Cecile H. Edwards, Evelyn L. Gadsden, and Gerald A. Edwards (Agricultural and Technical Coll. of North Carolina, Greensboro). Metab. Clin. Exptl., 13: 373-80(Apr. 1964).

A study was made of the effectiveness of pre- and post-irradiation doses of methionine and combinations of homocysteine, choline, and betaine on body weight, reproductive performance, malignant growths, and plasma protein and cholesterol concentrations in Wistar rats exposed to 700 r of x irradiation. Both male and female rats fed homocysteine, choline, and betaine fared better with regard to maintenance of weight during the 10 days following irradiation. Plasma cholesterol values for male irradiated controls and irradiated rats fed methionine were one-half those of the homocysteine group and lower than those of nonirradiated males. High cholesterol levels of the homocysteine-, betaine-, and choline-supplemented group suggests abnormal synthesis and/or metabolism of cholesterol in the livers of these rats as this organ plays a major role in the maintenance of blood cholesterol concentrations. Cholesterol concentrations of female rats fed homocysteine were the same as those of controls. Concentrations of γ-globulin and albumin in male rats fed homocysteine were more similar to values of nonirradiated controls than those of other groups. Necropsy one yr following x irradiation revealed a higher incidence of eye cataracts in the irradiated controls and methionine-supplemented rats than in the homocysteine-supplemented group, indicating that homocysteine protected against the development of cataracts in these rats. Methionine and homocysteine appeared to have prevented hypertrophy of kidney and spleen; organs of the reproductive system were atrophied in all groups of male rats. Homocysteine appeared to protect the lung and heart of female rats. (BBB)

31287 IONIZING RADIATIONS AND SULPHYDRYL GROUPS. F. Bosio and G. Agati (Università, Turin). Minerva Radiol., Fisioterap. Radiobiol., 8: 485-92(1963).

After a brief review of the chemistry and biochemistry of -SH groups, their biological significance and role in various cellular metabolic cycles are discussed. A detailed description is given of the mechanisms of interaction between -SH groups and ionizing radiations and reference is made to the most important experimental research carried out on this subject and to the most valid theories on two phenomena: the action of ionizing radiations on cellular -SH groups, and the importance of chemico-radioprotection by means of sulfhydryl substances. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31288 STUDIES ON THE RESTORATION FROM RADIATION DAMAGE WITH CHEMICAL TREATMENTS: A PRELIMINARY REPORT. Tsutomu Sugahara (Kyoto Univ.), Hiroji Nagata, et al. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 216-20(May 1963).

A remarkable increase in survival after repeated γ irradiations was observed in mice administered a nucleotide mixture from yeast RNA. A slight effect on body weight of mice irradiated similarly was demonstrated in mice fed laboratory chow supplemented with desiccated liver. The experiments are not extensive enough to support a new method of chemical treatment after exposure, but the re-

sults obtained so far suggest the possibility of enhancing recovery from radiation damage by chemical treatments. (auth)

31289 EFFECT OF SALIVA-PAROTIN-A UPON THE LEUKOPENIA OF RABBITS CAUSED BY X-IRRADIATION. Masato Shinoda, Yoshinari Takagi, et al. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 225-30(May 1963). (In Japanese)

Saliva-Parotin-A, a purified protein (mol wt, 16,000) extracted from human saliva, is known to cause transient decrease in the number of circulating leukocytes in rabbits, followed by marked increase beyond the initial level for hours after a single intravenous injection of 10–50 μg/kg. After an injection of 1–5 μg/kg intravenously or 3 mg/kg subcutaneously, the transient decrease in the leukocytes was not observed, but the marked increase was induced in the later period. Further analysis of the nature of the leukocytes showed that the latter response was mainly due to the increase in the granulocytes, and that lymphocytes and monocytes, on the other hand, slightly decreased. Saliva-Parotin-A injected into x-irradiated rabbits could increase the reduced granulocyte number to the same extent as intact animals. It was similarly effective when injected either 2 hours before or 5 minutes after irradiation. Daily intravenous injection of 50 μg/kg of saliva-Parotin-A for 4 days caused a gradual reduction in the responsiveness of leukocytes to the injection, and the injection on the 4th day caused only a slight increase. Similar failure of the response was observed after the 5th injection when 50 μg/kg was given every other day. After various trials, it was found that the decreased number due to irradiation could be elevated and sustained as long as 17 days by intravenous injection of 50 μg/kg of saliva-Parotin-A every three days. (auth)

31290 THE EFFECT OF LEYK (CYSTEINE DERIVATIVE) ON THE RADIATION INJURY. Hideyuki Haruna, Shiniji Suzuki, et al. (Keio Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 685-97(Sept. 1963). (In Japanese)

The effect of Leyk (2-α-phenyl-α-carboethoxymethyl-thiazolidine-4-carbonic acid) on radiation injuries was studied and fairly good results were obtained. The Leyk was given to 50 patients, 48 of them irradiated (17 by x rays and 31 in ^{60}Co teletherapy) and 2 suffering from anemia caused by irradiation. For contrast, the peripheral bloods were observed in 420 patients with malignant tumors and benign ones. About 30% of the 420 already had anemia and badly needed some kind of hemostatic when irradiated. Most of the patients were given daily 60 mg of Leyk for 30 days; the remaining few received more than this amount for the same period. It was found that hemoglobin, erythrocyte, leucocyte, reticulocyte, and thrombocyte in the peripheral bloods did not decrease during irradiation and the Leyk had no perceptive good effect in those patients who already had anemia. The albumin and A/D in the serum protein decreased even when the Leyk was applied, but in protein they increased a little. The non-protein nitrogen decreased when it was applied. A decrease of this kind was also observed for Cl, Na, K, and alkali-acid-phosphatase, but Ca increased. In general, the Leyk evidently had no good effect on the liver function but a protective effect on the G.O.T. Most of the patients made no complaint of sickness when they were given the Leyk continuously from the beginning of irradiation. The Leyk had no good effect in those patients who already had radiation sickness. The Leyk had few side effects except a little gastrointestinal complaint. It was concluded that, if used from the beginning of irradiation, Leyk is very effective in protecting radiologists and patients from radiation injury. (auth)

31291 STUDIES ON THE PROPHYLAXSIS AND THERAPY OF THE LEUKOPENIA CAUSED BY Co^{60} IRRADIATION. Momoe Soeda (Japan Defense Agency). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 735-40(Sept. 1963). (In Japanese)

The protective and therapeutic effects of marinamycin (M^2) on leukopenia caused by Co^{60} irradiation were studied. The leukopenia of a rabbit caused by local or whole-body irradiation of 300, 350, or 400 r required more than 4 weeks for spontaneous recovery. When 5.0 mg of M^2 was administered intravenously or hypodermically 2 to 4 hr before irradiation, leukopenia did not occur after a dose of 300 r in the pygal region of the rabbit. The leukopenia caused by a dose of 300 r in the same region was rapidly cured when 1.0 mg of M^2 was administered 3 times, starting 3 days after irradiation. A protective effect was also observed for a whole-body dose of 300 r when 2.0 mg of M^2 was administered intravenously or hypodermically 2 to 4 hours before irradiation. In the administration of M^2 1 or 2 times after irradiation, leukopenia was rapidly cured for a dose of 400 r. It was found that the protective and therapeutic effects of M^2 were superior to those of adenine sulfate, dencyl kinetine, or solcoseryl. (NSA of Japan)

31292 EFFECT OF SEX HORMONES ON THE COURSE OF ACUTE RADIATION SICKNESS. S. A. Davidova. Patol. Fiziol. i Eksperim. Terapiya, 7: No. 5, 45-8(Sept.-Oct. 1963).

Though the importance of the organism's radiosensitivity to hormonal conditions is unquestioned, data on individual hormones is very contradictory and irregular. Six estrogenic preparations are studied for the comparative effectiveness of their protective and therapeutic action: natural folliculin, its synthetic analogs—diethylstilbestrol, synestrone, dimestrone, ethynylestradiol, and octestrol, and also androgens—testosterone propionate and methyltestosterone. A total of 1181 white mice and 555 white rats of both sexes given total single irradiation by ^{60}Co γ rays at a source strength of 431 to 360 r/min were used, mice doses were 650 and 700 r, and rat doses 700 and 750 r. The hormonal preparations were given either externally in aqueous solution (methyltestosterone, ethynylestradiol, and octestrone) or subcutaneously in oil solutions in doses of 0.1 to 10 mg, once or twice during 5 to 10 days or 1 hr before irradiation. Control animals were given analogous amounts of apricot oil. Preparation effectiveness was judged by survival rate, clinical picture, wt changes, average longevity of perishing animals, and leucocyte number. Results of individual hormone use independently of schedules proved the same, affording merging of research material. Data presented shows in opposition to some authors that not all estrogens are anti-radiational. Their action is selective by species and sex of animals, appearing more often in males and less often in females. Testosterone and folliculin proved most protective, less so were methyltestosterone and diethylstilbestrol, and least effective—synestrone. The preventive effect of sex hormones was considerably weaker in rats than mice, in agreement with the literature. (OTS)

31293 PROTECTIVE EFFECT OF INERT GASES AND LOW-MOLECULAR-WEIGHT NARCOTICS. I. ABSENCE OF PROTECTIVE EFFECT OF COMPRESSED NITROGEN IN IRRADIATION OF ESCHERICHIA COLI B/r IN AQUEOUS SUSPENSION. V. P. Paribok and E. A. Val'dshtein

(Inst. of Cytology, Leningrad). Radiobiologiya, 4: 186-90(1964). (In Russian)

Suspensions of bacteria in a specially constructed vessel were irradiated with roentgen rays up to 31.5 krad. When the O content of the chamber gas was 10, 5, or 1% (0.1, 0.05, or 0.01 atm), N at 20 atm showed no protective effect. When the O content was decreased to 0.5% (0.005 atm), points on the irradiation dose curves for controls and for 0.5% O with 40 atm of N were about the same, and damage was low compared to that in air but high compared to that in N alone. If the protective effect of N is due to absorption competitive with O, these conditions should be very favorable, but even at 60 atm of N there was no protective effect. These results indicate a diffusion rather than an absorption mechanism for the protective effect of compressed gas. However, more work is required to verify this. The vessel used for the irradiations, which was constructed of stainless steel, contains a compressor. The vessel is described in some detail. (TTT)

31294 PROTECTIVE EFFECT OF INERT GASES AND LOW-MOLECULAR-WEIGHT NARCOTICS. II. EFFECT OF NITRIC OXIDE AND NITROGEN UNDER PRESSURE ON RADIATION DAMAGE TO VICIA FABA SPROUTS. V. P. Paribok and V. S. Kal'nil (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 191-6(1964). (In Russian)

Five-day sprouts of Vicia faba were irradiated at a rate of 45 r/min up to doses of 450 r. In the absence of irradiation, nitric oxide had an insignificant toxic action, as shown by the percentages of chromosome aberrations. The reported radiosensitizing ability of nitric oxide was verified, this effect being shown with as low as 0.4% nitric oxide. Nitrogen at 20 atm pressure had a definite protective effect in air, but there was no such effect in the presence of 0.01 atm of nitric oxide. This indicates a diffusion mechanism for the protective effect of compressed N. At O concentrations of 9 and 6.6% (0.09 and 0.66 atm; 20°C), the protective effect of compressed N increased greatly and even at 5 atm N was greater than at 20 atm of N with air at 0.2 atm. Nitric oxide at concentrations of 0.65 and 0.4% (0.065 and 0.004 atm) had a smaller but noticeable radiosensitization effect, that with 0.4% being the same as with 4% O at 20°C. With these nitric oxide concentrations there was no protective effect of compressed N. The addition of 20 atm of N to air doubled the percentage of chromosome aberrations, but the addition of 20 atm of N to 0.007 atm of nitric oxide decreased the number of damaged cells only from 34.7 to 31.9%. (TTT)

31295 RELATION OF RADIOPROTECTIVE ACTION OF INDOLYLALKYLAMINES TO TISSUE HYPOXIA AND THE ROLE OF VASCULAR CHANGES IN ITS ORIGIN. E. Ya. Graevskiĭ, P. G. Zherebchenko, M. M. Konstantinova, O. M. Sokolova, and A. N. Shevchenko. Radiobiologiya, 4: 197-202(1964). (In Russian)

Experiments were carried out with white mice of both sexes, weighing 18 to 20 g. The O tension in the tissues and the distribution of neutral red in the organs were determined after administration of various protective compounds (4- and 5-chloro-, 4- and 5-methoxy-, and α-methyltryptamine; serotonin; cystamine; and diethylamide of lysergic acid). Data are presented in graphic and tabular form. The high protective effect of 5-methoxy- and 5-chloro-tryptamine is attributed to their ability to create a hypoxia in the radiosensitive organs. This lowering of the O tension is the result of a spasm in the blood vessels in these organs, which is shown by a decrease in the accumulation of dye in these organs. The 4-substituted compounds, which have no protective action, did not cause changes in the blood vessel tonus or the O level in the tissues. Substances that neutralize the protective action, i.e., α-methyltryptamine and lysergic acid diethylamide, prevent the development of blood vessel spasms and hypoxia. Cystamine, which increases the radioprotective action of the tryptamine derivatives, had no effect on their vasoconstriction action or the hypoxia. (TTT)

31296 ANALYSIS OF THE DEPENDENCE OF THE PROTECTIVE ACTION OF HYPOXIA ON THE RADIATION DOSE. I. B. Bychkovskaya and G. K. Ochinskaya (Central Science Research Inst. for Medical Radiology, Leningrad). Radiobiologiya, 4: 203-9(1964). (In Russian)

Grain weevils (Calandra granaria) were x-irradiated in a 2% O atmosphere (controls in the usual, 20%, O concentration) at 500 r/min with doses of 1 to 150 kr. Survival data, presented in tabular form, indicated that under ordinary O conditions, doses of 1 to 3.5 kr are not lethal at 50 days. Lethality increased with dose, to 100% at 8 kr. Length of life was dose-dependent up to 35 kr, averaging 20 days with 5 to 35 kr, decreasing to 14 days at 40 to 70 kr, and to about 10 days at 75 to 150 kr. Under hypoxia conditions, 100% lethality at 50 days did not occur until the dose reached 13 kr; lifetimes averaged 20 days with from 9- to 50-kr doses, about 13 days with 55- to 80-kr, and about 10 days with 85- to 150-kr. The effects of hypoxia in decreasing the irradiation damage are presented as the ratio of doses, with an 8-kr dose under hypoxia conditions corresponding to 3.5 kr under ordinary conditions, or a ratio of 2.28. The ratio gradually decreased to 1.14 (85/75) at the higher levels. (TTT)

31297 EFFECT OF OXYGEN CONCENTRATION ON THE EFFECTIVENESS OF ESCHERICHIA COLI B/r PROTECTION BY CYSTEAMINE. E. A. Val'dshtein (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 210-5(1964). (In Russian)

Aqueous suspensions of 18-hr cultures of E. coli B/r were irradiated at a rate of 1000 rad/min in oxygen–nitrogen atmospheres containing 0 (actually 10^{-4}%), 1, 2, 10, 21, or 99.5%. The cultures were grown on meat–peptone agar. Cysteamine, when given, was introduced to a concentration of 0.02 M 30 min before the irradiation. With radiation doses of 0 to 18 krad for all concentrations, the viability of the organisms was greater in the presence of cysteamine. However, the protective effect of this compound was greatest with 1 to 2% O. The sensitization effect of O increases sharply from 0 to 1%, then increases slowly to 20%, but changes little with further increase to 100%. The cysteamine protection mechanism is undoubtedly related to the O effect. The lower protective effect of cysteamine with 10 to 100% O may possibly be explained by a partial inactivation of the cysteamine. Curves of Kohn and Hunter for cysteine are given for comparison with the cysteamine data. (TTT)

31298 STUDIES OF THE PROTECTIVE EFFECT OF N-ALKYL DERIVATIVES OF 2,3-MERCAPTOPROPYLAMINE AND THE MECHANISM OF THEIR ACTION. M. M. Konstantinova, A. G. Tarasenko, and V. M. Fedoseev (Severtsov Inst. of Animal Morphology, Moscow and Moscow State Univ.). Radiobiologiya, 4: 216-20(1964). (In Russian)

Adult white mice of both sexes, 8 to 12 weeks old and weighing 18 to 20 g, were irradiated (^{60}Co) to 900 r ($LD_{100/15}$) at a rate of 270 to 280 r/min. The compounds studied were administered to the animals 15 to 90 min before the irradiation, and their radioprotective effect was studied by the survival of the animals to 30 days, the average length of life of those dying in this time, and the O tension in the liver and spleen. Curves were plotted for each compound.

The data indicate a correlation between the protective effect of the subject compounds and the level of hypoxia in the spleen. However, the absence of a correlation between changes in the radiosensitivity and hypoxia in the spleen makes this correspondence somewhat less clear than in the case of the biological amines. The non-coincidence of these processes may result from some toxicity of the preparations themselves. The compounds studied were 2,3-dimercaptopropylamine and its N-ethyl, N-propyl, N-butyl, N,N-diethyl, N,N-dipropyl, and N,N-dibutyl derivatives. (TTT)

31299 RADIOPROTECTIVE EFFECT OF β-AMINOETHYLISOTHIOUREA Br · HBr(AET) ON THE HEREDITARY STRUCTURES OF MAMMALIAN TISSUES. Yu. Ya. Kerkis and Yu. N. Naumenko (Inst. of Cytology and Genetics, Novosibirsk, USSR). Radiobiologiya, 4: 221-5(1964). (In Russian)

Male mice, 2.5 to 3.5 months old, were irradiated 10 min after administration of AET in distilled water. Radiation doses were 25, 50, 100, or 200 r at a rate of 4 r/min. Animals were sacrificed 24 hr after irradiation, and the eye, bone, and gonad tissues were fixed in alcohol–acetic acid and stained for examination. The degree of protection was estimated from the number of chromosome aberrations. AET gave weak protection to the eye tissue chromosome apparatus with 25- or 50-r doses and none with 100- and 200-r doses. In the bone marrow protection was complete to 100 r and was 78% effective with 200 r. Spermatocyte protection to 100 r was slight and to 200 r was nonexistent. AET showed no marked effect on spontaneous chromosome rearrangements. The amounts of AET given were, per animal, 10 mg in the 25-r-dose series, 5 mg in the 100- and 200-r series, and 3, 5, and 10 mg in the 50-r series. In the last experiment the degree of protection varied markedly in the different animals but was not dependent on the dose of AET administered. (TTT)

31300 MECHANISM OF ACTIVATION OF REPAIR PROCESSES IN BONE MARROW OF IRRADIATED ANIMALS PROTECTED BY AMINOETHYLISOTHIOUREA Br · HBr(AET). N. F. Barakina and M. I. Yanushevskaya (Severtsov Inst. of Animal Morphology, Moscow). Radiobiologiya, 4: 226-33(1964). (In Russian)

Experiments were carried out on adult white mice weighing about 20 g. The AET was administered in distilled water 7 to 15 min before the irradiation, which was at a rate of 50 r/min for a total dose of 700 r. Protection was estimated from the viability of the animals and the number of chromosome aberrations in the bone marrow cells. The irradiated control animals were all dead at 11 days, but in those given AET, 9 to 10 mg per animal, survival was 75 to 98% at 30 days. The total cells in the bone marrow dropped to approximately 20% on the second day in both groups, but then rose to approximately 75% of normal by the eighth day in the protected group while continuing to fall in the controls. The percentages of hemocytoblasts followed a similar pattern, but leukocytes decreased to 40% on the second day in both groups, and only by the fifth day did they become much higher in the protected group. This is explained by the beginning of regeneration of the immature white cells. Plots of changes in the mitotic index of the bone marrow cells were complex, but averages were higher in the protected animals. (TTT)

31301 EVALUATION OF THE RADIOPROTECTIVENESS OF β-AMINOETHYLTHIOUREA (AET). I. B. Bychkovskaya and G. S. Novoselova (Central Science Research Rontgeno-Radiological Inst., Leningrad). Radiobiologiya, 4: 234-8(1964). (In Russian)

Experiments were carried out on nonpedigreed male white mice weighing 18 to 20 g. The animals were irradiated at a rate of 76.5 r/min to doses of 300 to 1200 r. AET, 1% solution, was administered 15 min before the irradiation at a rate of 150 mg/kg of animal weight; controls were given physiological saline. The number of animals surviving at 30 days decreased from 100% at 300 r to 0 at 600 r in the control group, while the average life decreased from 16 days at 400 r to 3.5 days at 1200 r. In the protected group, zero survival at 30 days was not reached until a dose of 1000 r, while the average lifetime decreased from 14 days at 500 r to 3.5 days at 1200 r. The ratio of doses at which damage is similar (500 r/400 r = 1.25; 600/475 = 1.26; 700/600 = 1.17, etc.) was about the same for different doses. The decrease in irradiation damage resulting from administration of AET is thus about 25 to 30%, and the AET protective action thus appears to cause a decrease in the overall irradiation effect. The results indicate that radiation-protection effectiveness should be evaluated with a wide range of radiation doses. This would be recommended for other protective agents, also. (TTT)

31302 ROLE OF OXIDATIVE DEAMINATION IN THE MECHANISM OF RADIATION PROTECTION BY INDOLYLALKYLAMINES. P. G. Zherebchenko and I. G. Krasnykh. Radiobiologiya, 4: 239-43(1964). (In Russian)

Experiments were carried out with mice of both sexes, weighing 19 to 21 g. The circulation in the internal organs was judged by the hemoglobin in them and the distribution of neutral red. Controls were given physiological saline. In the experimental animals given 5-methoxytryptamine (50 mg/kg) the accumulation of the dye was lower in the spleen and skin and higher in the brain, lungs, muscles, and kidneys than in the controls. That in the liver was the same. α-Methyltryptamine (15 mg/kg) alone had an insignificant effect. However, when the monoamine oxidase activity was suppressed by the administration of α-methyltryptamine 1 hr before the methoxy compound, the effect on the distribution of neutral red was significantly decreased. Phenylisopropylhydrazine (30 mg/kg) given 5 hr before the methoxy compound or Iproniazide (100 mg/kg) given 22 hr in advance were similar in their action. When animals given similar combinations of these compounds were irradiated, 5-methoxytryptamine alone increased the viability and length of life. Iproniazide did not affect its action, but phenylisopropylhydrazine decreased it slightly. The latter compound alone had no effect on viability or length of life. (TTT)

31303 INTERACTION OF SULFUR-CONTAINING RADIOPROTECTIVE AGENTS WITH TISSUE PROTEINS. V. G. Yakovlev and L. S. Isupova. Radiobiologiya, 4: 244-7(1964). (In Russian)

The radioprotective agents cysteine, its n-propyl ester, β-mercaptopropylamine, azidodithioformic acid, and diethylthiocarbamate were synthesized, tagged with ^{35}S, for use in the determination of whether these compounds enter into the composition of liver and spleen proteins. Experiments were carried out with unpedigreed male rats weighing 180 to 200 g. Aqueous solutions of the compounds were given to them 30 min before decapitation and removal of the organs for analysis. Cysteine, its n-propyl ester, and β-mercaptopropylamine were found chemically bound to the protein. The cysteine propyl ester bond to the protein was somewhat stronger than that of cysteine, possibly because of the higher penetrability of the ester. A large part of the mercapto compound was bound through the disulfide linkage. The protective compound containing the dithioformate group,

that is, azidodithioformic acid, did not form a stable compound with the proteins of the liver and spleen. (TTT)

31304 EFFECT OF SODIUM NITRATE ON RADIATION DAMAGE TO THE SMALL INTESTINE. I. B. Smirnova (Severtsov Inst. of Animal Morphology, Moscow). Radiobiologiya, 4: 248-52(1964). (In Russian)

Experiments were made with white mice weighing 20 to 22 g, which were given a single whole-body irradiation of 700 or 1300 r. Sodium nitrate (3.2 mg in 0.5 ml of water) was given to the experimental animals 40 min before the irradiation. The controls were given nothing. The animals were sacrificed 24 to 96 hr later, and the epithelium of the crypts of the small intestine mucosa was examined for number of cells on the midlines of the crypts, mitotic activity, and number of cells with chromosome aberrations. The number of cells on the crypt midlines dropped to 50% of normal in all cases at 24 to 48 hr after irradiation, but in the 700-r-irradiated group all then began to recover, reaching normal values at about 72 hr. In the 1300-r-irradiated group, the nontreated animals died at 72 hr, but both the animals treated with sodium nitrate and a group treated with AET for comparison recovered completely by 96 hr. Changes in the mitotic index were similar, with somewhat more rapid recovery. The number of cells with chromosome aberrations decreased constantly from 70% in 24 hr to 20% in 72 hr in all groups except the 1300-r-irradiated controls, which showed about 70% at 72 hr. (TTT)

31305 MECHANISM OF ACTION OF INDOLE PROTECTANTS IN IRRADIATION OF ANIMALS WITH TUMORS. E. N. Tolkacheva (Inst. of Biophysics, Moscow). Radiobiologiya, 4: 253-8(1964). (In Russian)

Experiments were made on two mammalian tumors, the Ehrlich ascitic carcinoma in mice and the solid sarcoma 45 in rats. The mice weighed 20 to 25 g and the rats, 100 to 130 g. Damage was assessed, after irradiation, by determining the percentages of chromosome aberrations in or weight of the tumor, respectively. The compounds tested, Serotonin (5-hydroxytryptamine) and Mexamine (5-methoxytryptamine hydrochloride) were shown to protect normal tissue. Animals given Serotonin or Mexamine were significantly protected in total-body irradiations of 800 and 1500 r, respectively. The method of introduction of the protectant determined whether the tumor cells would be protected. For example, Serotonin protected Ehrlich ascitic carcinoma cells when the interval between administration of the protectant and the irradiation was increased from 10 to 20 to 30 min. Mexamine protected the cells of both the Ehrlich and the solid carcinoma when it was given by mouth instead of subcutaneously. The reason these compounds do not protect the tumor cells when used in irradiation of tumors under optimum conditions for protection of normal tissues is considered to be an insufficient concentration of the protectant in the tumor cells at the moment of the irradiation. (TTT)

31306 SOME PECULIARITIES OF RADIOPROTECTIVE PROPERTIES OF MONOSODIUM β-AMINOETHYL THIOPHOSPHATE. G. M. Airapetyan and P. G. Zherebchenko. Radiobiologiya, 4: 259-65(1964). (In Russian)

Experiments were made with white mice (19 to 22 g) and white rats (150 to 200 g), which were x-irradiated with 700 to 900 g, and with dogs, which were γ-irradiated with 300 r at 260 to 280 r/min. The survival of the mice and rats at day 30 and of the dogs at day 45, the average lifetimes, and the dynamics of the weight changes were used as criterions. Survival rates of mice given intraabdominally 250 to 600 mg/kg of this phosphate derivative were 70 to 90% and of those given 500 to 700 mg/kg by mouth were 17 to 60%, depending on the time of administration. Cystamine given by mouth for comparison caused survival rates of 12 to 44%. Average lifetimes were 16 to 22, 11 to 17, and 9 to 15 days, respectively. Monosodium β-aminoethyl thiophosphate given subcutaneously did not cause a local necrosis and was effective in both rats and mice. The protective effect in dogs was somewhat less than that in mice and rats. The best radiation protection was obtained when monosodium β-aminoethyl thiophosphate was administered, followed by 5-methoxytryptamine. (TTT)

31307 RADIOPROTECTIVE ACTION OF THIAZOLIDINES. F. Yu. Rachinskiĭ, M. S. Kushakovskiĭ, B. V. Matveev, N. M. Slavachevskaya, and L. I. Tank (Kirova War Medicine Order of Lenin Academy, Leningrad). Radiobiologiya, 4: 266-9(1964). (In Russian)

The effects of the nature of substituents in position two of the thiazolidine ring on the rate of hydrolysis and correlation of the data with the protective effect of the substituted compound were studied. The nature of the substituent was shown to affect the hydrolysis, but no correlation between stability of the compound and its protective effect was found. Some data were obtained which indicated that a partial correlation exists between the protective effect and the ability of thiazolidines to reduce methemoglobin in hemolysates. The protective effect of a number of compounds was determined in 2000 white mice of both sexes, weighing 19 to 20 g, the preparations being given intraabdominally before irradiation. Ten compounds were effective, of which 2,2-dimethylthiazolidine and 2-phenylthiazolidine protected more than 50% from death. However, the protective dose was close to the toxic amount. Some of the others that were partially protective were easily hydrolyzed. The stability of aqueous solutions of thiazolidine and some of its 2-substituted derivatives to the action of equal doses of ionizing radiation was approximately the same. (TTT)

31308 PROTECTIVE ACTION OF METABOLITES OF RADIORESISTANT PLANTS. O. N. Sorokina, I. D. Anikeeva, and E. L. Iofa (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 279-83(1964). (In Russian)

Extracts were prepared from the dry seeds of eleven species of radioresistant plants from different families and from the vegetative parts of a moss. The effects of these extracts on the radiosensitivity of barley seedlings given a 500-r dose of x radiation were studied. As indicated by the percentages of chromosome aberrations, the extracts from the following seeds have a positive protective effect: Nigella 55%, flax 38%, radish 38%, nasturtium 25%, mustard 23%, calendula 19%, Amaranthus 16%, and Eschscholtzia 13%. The cabbage, carrot, and Aquilegia extracts had a negative effect on survival, growth, and mitosis. In this series the extract was present 19 hr before, during, and 19 hr after the irradiation. When the extract was present 24 hr before irradiation but not during or after, the protective values were Nigella 13% and radish 23%. With only 1 hr prior exposure to the extract, values were Nigella 23% and radish 5%. Moss extract showed 20 to 73% protection depending on the concentration. Different radiation doses and different extract concentrations were briefly investigated. (TTT)

31309 DISCUSSION OF PARTICIPATION OF OXYGEN IN RADIOBIOLOGICAL EFFECTS. L. Kh. Eĭdus (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 329-34 (1964). (In Russian)

An explanation is offered for the O effect that occurs in irradiated suspensions of phage to which cysteine or cyst-

amine is added. The OH^- radicals, which are formed in the radiolysis of water, damage the macromolecules. Radicals of any low-molecular-weight component are also formed. The macromolecules damaged may be repaired from the early stages by reaction with the radicals of such component compounds, especially sulfhydryl compounds. Oxygen present deactivates these radicals, increasing the damage in comparison with anaerobic irradiations. Study of the dependence of the value of the O effect on the substrate concentration with constant concentration of the minor component and O may be a basis for selecting between this theory and some of the others that were proposed. A basic fact in studying irradiation effects for the increase of the O effect with increase in the partial pressure of O, within definite limits, above it is that the O effect does not change. A reverse as well as a direct O effect is possible, the introduction of O sometimes having a protective effect. The O effect is absent when strongly ionizing radiation is acting, and then chemical protectants have no effect. The possibility of explaining the various effects by the new theory is discussed at length. (TTT)

31310 EFFECT OF A NEW ANTIPHLOGISTIC AGENT ON IRRADIATION REACTION. R. Fridrich (Universität, Basel). Schweiz. Med. Wochschr., 93: 1634-5(1963).

Prophylactic medication with Tanderil does not prevent the reaction of mucosa to radiotherapy. From the clinical standpoint, the undulating character of the reaction remains, apart from individual differences. Nor can the delayed reaction be prevented. However, the administration of Tanderil does serve to postpone the reaction, i.e., it becomes manifest only after larger radiation doses. Subjective symptoms are substantially reduced, and acute conditions due to post-irradiation edema were no longer observed under prophylactic treatment with Tanderil. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31311 PROGRESS AND PROBLEMS IN HUMAN ORGAN TRANSPLANTATION. Ronald D. Graber and Frederick W. Preston (Veterans Administration Research Hospital, Chicago). Surg. Clin. North Am., 43: 163-77(Feb. 1963).

Problems resulting from the homograft rejection response, and the use of ionizing radiation and cytostatic drugs to suppress this response, are reviewed with citation of 62 references. Clinical experience in the use of radiation and/or drugs to prolong survival of transplanted organs, especially kidneys, is assessed. A brief survey is also provided of investigations of bone marrow homotransplantation after total-body irradiation or marrow-depressant chemical therapy in the treatment of patients having leukemia, disseminated cancer, or marrow-depletion states. The importance of marrow transplantation is emphasized, in view of the increasing hazard of irradiation injury, such as in physicists and those employed in the widening field of applied radioactivity. It is suggested that marrow acceptance may prove to be the most difficult of all transplantations to achieve in man. (OTS)

31312 BIOLOGIC MECHANISMS OF PROTECTION AGAINST RADIATION. Charles C. Congdon (Oak Ridge National Lab., Tenn.). p.578-81 of "Proceedings of XII International Congress of Dermatology, Washington, D. C., Sept. 1962. Excerpta Medica International Congress Series No. 55."

The general problem of whole-body irradiation damage, the radiation syndrome as it is seen in mammals, the phenomenon of chemical protection which has a remarkable ability to neutralize radiation damage, and finally, the matter of bone marrow transplantation as an experimental method for treating lethal irradiation exposures are considered. (auth)

31313 MERCAPTOPYRIDOXINE AS A CHEMICAL PROTECTIVE AGENT IN THE MONKEY. Donald R. Anderson, Frances Quinn, and Alexander Hernandez-Diaz (School of Aerospace Medicine, Brooks AFB, Tex.). 16p. (CONF-500-4)

From Conference on Radiation Protection and Recovery, Oak Ridge, Tenn., Nov. 1963.

Mercaptopyridoxine (B.I) protected rats against a single acute dose of 1,000-r γ radiation and rhesus monkeys against a single acute dose of 900 r. The compound was not effective against radiation injury in rats exposed to fractionated doses of 200 r/week over a period of several weeks to a total accumulated dose of 3,800 r. It was concluded that chemical protective agents are not effective against fractionated or chronic radiation exposure. (C.H.)

Radiation Hazards and Protection

31314 NEUTRON DOSIMETRY. METHODS USED IN RADIOBIOLOGY AND DETERMINATION OF DOSES IN RADS. Y. Arnaud. Bull. Inform. Sci. Tech. (Paris), No. 82, 58-62(Apr. 1964). (In French)

Several methods for neutron dosimetry were investigated for radiobiological experiments. The methods are of two types, those giving directly the absorbed dose in rads, and those making use of flux and spectra determinations. From the first group equivalent chambers and counters with one tissue, chemical measurements, and biological measurements were chosen. Among the analytical methods tried were: fission chambers, nuclear emulsions, and a threshold detector. The results made it possible to choose a process that is well suited to the demands of the biologist. (P.C.H.)

31315 DOSIMETRY APPLIED TO RADIOPROTECTION. A. Barthoux, G. Benezech, M. Bricka, G. Portal, G. Soudain, H. Zaborowski, H. Joffre, P. Tardy-Joubert, and J. Lamberieux. Bull. Inform. Sci. Tech. (Paris), No. 82, 66-73(Apr. 1964). (In French)

Dosimetry methods used in radioprotection are reviewed. Discussion is presented on: neutron dosimetry; dosimetry of personnel by photography, nuclear emulsions, and radiophotoluminescence; and dosimetry of external radiation by measurement of the absorbed dose, which includes general characteristics of dosimeters and dosimetry of fast neutrons and photons. (P.C.H.)

31316 CAESIUM-137 FALL-OUT BODY BURDENS, TIME VARIATION AND FREQUENCY DISTRIBUTION. William H. Ellett and Gordon L. Brownell (Massachusetts General Hospital, Boston). Nature, 203: 53-5(July 4, 1964).

Muscle samples weighing 90 to 140 g were dissected from the thigh or lower abdomen during routine post-mortem operations. Samples were not collected from patients who had received isotopes for medical purposes or who died of highly infectious disease. Dried samples were counted and final data expressed in picocuries/g of defatted dry muscle. When the samples were analyzed separately for each sex, the mean sample activity per g of muscle for men was 10% greater than that of women. Sample activity variations with time were correlated with the status of nuclear testing. Cesium-137 body burdens were found to have symmetric distribution and to be generally lower in the United States than in Europe. From

this study, it was estimated that about 75,000 persons per 50 million would exceed the U. S. Federal Radiation Council criterion for permissible total population exposure. (H.M.G.)

31317 DOSE ESTIMATION OF LIMITED EXPOSURE USING OLD X-RAY UNIT. Kenji Takeshita and Hitoshi Katayama (Kyushu Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1339-44(Feb. 1964). (In Japanese)

Dose estimation was tried for a laboratory worker photographing the x-ray diffraction pattern of metals, whose right hand was injured by x-rays of a mechanically rectified x-ray unit during 1920 to 1921 and from 1923 to 1934. The radiation dose was evaluated from both old references about early x-ray apparatus and measured values for present-day machines. Estimated value for his fingers was 21000 r. (auth)

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Refer also to abstract 31809.

31318 (OTS-63-11409/6(p.949-58)) THE TECHNIQUE OF HYPOPHYSIS DESTRUCTION WITH YTTRIUM 90 IN THE LIGHT OF OWN EXPERIENCE. C. Górski and Z. Malinowski. Translated from Polish Med. J., 2: No. 6, 949-58(1963).

Also published in Nowotwory, 13: No. 1, 1963.

The destruction of the pituitary hypophysis with ^{90}Y is used in palliative treatment of advanced mammary cancer, prostatic cancer, and advanced diabetes. The technique of intrahypophyseal introduction of ^{90}Y pellets by the intranasal route is described. Results in nine cases are described. (C.H.)

31319 PROGRESS IN MEDICAL DIAGNOSTICS WITH RADIONUCLIDES. E. H. Graul (Universita, Marburg Lahn, Ger.). Acta Isotopica, 3: 197-223(1963). (In Italian)

The significance of nuclear medicine in diagnostic and research work is discussed. Information obtained on the diencephalon-hypophysis-thyroid-periphery automatic control loop by use of radionuclides is analyzed from the cybernetic point of view. Possibilities for reducing the radiation burden in the diagnostic use of radionuclides were indicated by in vitro tests, the accuracy and reliability of which are discussed. Applications of radioisotope tracer techniques in radiocariocirculography are also discussed. A simultaneous radiotest device is described that makes possible the simultaneous determination of more than 20 important measurement factors in the cardiac and circulatory system. (C.H.)

31320 DISTRIBUTION IN THE BLOOD OF RADIOISOTOPES USED FOR CEREBRAL TUMOUR DIAGNOSES STUDIED IN EXPERIMENTAL AND HUMAN BRAIN TUMOURS. F. Mundinger and H. Gerhard (Universität, Freiburg i. B.). Acta Neurochir., 11: 398-415(1963).

There has been very little investigation of the fundamental mechanisms of the take-up and storage of radioactive ions and of metallic complexes in experimental tumors and in human brain tumors. The work reported here using ^{74}As, ^{203}Hg–neohydrin as well as ^{64}Cu, ^{206}Bi, and ^{131}I in various compounds ought therefore to clarify some questions that are closely related to the selective concentration of these diagnostic isotopes in brain tumors. With density-gradient-electrophoresis and protein precipitation it was ascertained that globulin was the carrier protein for the circulation of ^{206}Bi, and albumin for the circulation of ^{203}Hg–neohydrin. Arsenic-74 in rats' blood had a high affinity for erythrocytes, and a negligible tendency to combine with the serum proteins. Using mouse tumor No. 48, the distribution was investigated of ^{206}Bi and ^{203}Hg–neohydrin in the tumor cells by means of fractional centrifugation. The main portion (30 to 50%) of ^{206}Bi and ^{203}Hg–neohydrin is bound to the cytoplasmic proteins of the tumor cells. The ^{206}Bi concentration (25 to 40%) in the tumor cell nuclei exceeded that of the mitochondria (15 to 25%). Similar distribution figures were found with ^{203}Hg–neohydrin. For the first time, the technique of fractional centrifugation was applied to human brain tumor tissue. With the help of density gradients a satisfactorily pure isolation of cell particles from different types of tumor could be obtained. By studying ^{206}Bi dispersion, it was found with meningiomata that 50% of the radioactive Bi was in the cytoplasm with a smaller take-up into the formed cell structures. In glioblastoma cells the ^{206}Bi concentration of the mitochondria (25%) exceeded that of the cell nuclei (20%) by a small margin. By contrast, with astrocytomata the cell nuclei possess more activity (40%) than the mitochondria (20%). With incubation of Ehrlich-, Yoshida-, and DS-ascites tumor cells, it was shown that ^{74}As in particular, also ^{131}I–PVP and ^{131}I–hippuran are not capable to enter the tumor cells. ^{131}I, which is presumably bound loosely to the cell membrane in very small quantities, and ^{131}I–albumin, which is only taken into the cell in small amounts (1 to 3%), also remain virtually extracellular. In contrast ^{64}Cu and its EDTA- and DTPA-complexes were stored in the tumor cells in high concentrations (50 to 60% of the initial activity). ^{206}Bi in nitrate-, citrate- and EDTA-complex form was found to be 30 to 50% intracellular. ^{206}Bi–DTPA remained extracellular. ^{203}Hg–neohydrin was taken up within the cancer cells in very small quantities. ^{206}Bi and ^{64}Cu were concentrated by ascites tumor cells a hundredfold in comparison with the surrounding medium. However, the tumor cells contain in addition small quantities of ^{74}As, ^{131}I, and ^{131}I–albumin which leads to the conclusion that distribution of these isotopes is by diffusion. If the results of these researches on brain tumors and isolated tumor cells can be confirmed, ^{206}Bi, ^{64}Cu, and ^{203}Hg–neohydrin would provide convenient indicators of the whole extra- and intracellular spaces of brain tumors as an aid to cell-type diagnosis. ^{74}As, ^{131}I, and ^{131}I–albumin which can only enter the extracellular space of the tumor would, according to these conclusions, permit a measurement of the degree of altered capillary permeability in the tumor and of the size of its interstitial extracellular space. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31321 AN IMPROVED ANGIOGRAPHICAL METHOD FOR EXPERIMENTAL WORK: PRELIMINARY NOTE. Jan Ekholm, Uno Eriksson, and Sten Skoglund (Karolinska Institutet, Stockholm). Acta Physiol. Scand., 60: 381-2 (Apr. 1964).

A newly developed technique is described that employs x rays and the contrast agent Thorotrast (colloidal ThO_2) to visualize the entire circulatory system of laboratory animals. The technique used to obtain visualization of the whole circulatory system consists of a slow (about 5-min) intravenous injection of Thorotrast (25%) in doses of 5 to 10 ml/kg. The radio-opaque material mixes with the blood during the injection, whereafter a good opacification of the circulatory system, which remains for two hr, is obtained. It was also determined by densitometry and measurements of radioactivity that the concentration of ThO_2 in the blood was fairly constant from 30 min up to 1

hr after giving 10 ml/kg of Thorotrast, making roentgenograms during this period quite comparable. Afterwards, successive accumulation of ThO_2 in the liver, spleen, and kidneys leads to a decrease in the blood concentration. The demonstrated method offers an excellent experimental situation for studying reactions in the vascular bed induced by physiologic or pharmacologic means. Other advantages of the method are presented. (BBB)

31322 A WEDGE FILTER FOR COBALT 60 SUPPLEMENTATION OF CARCINOMA OF THE CERVIX UTERI PREVIOUSLY TREATED BY RADIUM. G. R. Taylor (Northern Ireland Radiotherapy Center, Belfast). Acta Radiol., 1: 253-6(1963).

A Pb wedge filter is described which, when suitable placed in the radiation beam, ensures that the dose from the supplementary fields is a minimum at points already adequately irradiated by Ra and thereafter increases laterally in such a way that it matches the falling Ra dosage. A typical combined Ra and Co dosage distribution is illustrated and the effect of variation in the Co field size considered. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31323 RADIOACTIVE BISMUTH PHOSPHATE FOR THE TREATMENT OF CRANIOPHARYNGIOMA. E. Lindgren and G. Westberg (Serafimerlasarettet, Stockholm). Acta Radiol. (N.S.), 2: 113-20(Apr. 1964).

A method of treating cystic craniopharyngiomas using radioactive bismuth phosphate is presented. Two illustrative cases are described. (auth)

31324 TREATMENT OF MALIGNANT TUMOURS WITH 5-FLUOROURACIL IN 80 PATIENTS. Kare Myhre and J. Fjaerli (Ulleval Sykehus, Oslo). Acta Radiol. (N.S.), 2: 129-38(Apr. 1964).

The treatment of a series of 80 patients with 5-fluorouracil (5-FU) is reported. Mitomycin C was administered with the 5-FU in 56 of the patients without any apparent difference in the results. The results, considering the condition of the patients, were encouraging and the condition was improved when the medication was combined with radiotherapy. (auth)

31325 ALUMINUM WEDGE FILTERS FOR 220 TO 300 KILOVOLTAGE ROENTGEN RAYS. Paul N. Goodwin and Harry W. Adair (Johns Hopkins Hospital, Baltimore). Acta Radiol. (N.S.), 2: 145-9(Apr. 1964).

Copper wedge filters used in conventional roentgen therapy result in a high skin dose along the thin edge and a change in isodose slopes with depth. These disadvantages can be overcome by using a Thoraeus filter plus an Al wedge filter. The construction of Al wedges is described, measured isodose curves are shown, and the advantages of Al wedges are discussed. Data are given for the construction of Al wedge filters for a Siemens pendulum unit. (auth)

31326 EXPERIMENTAL APPROACH IN THE USE AND MAGNETIC CONTROL OF METALLIC IRON PARTICLES IN THE LYMPHATIC AND VASCULAR SYSTEM OF DOGS AS A CONTRAST AND ISOTROPIC AGENT. Ph. H. Meyers, Fr. Cronic, and Ch. Nice, Jr. (Tulane Univ., New Orleans). Am. J. Roentgenol., Radium Therapy Nucl. Med., 90: 1068-77(1963).

An experimental approach in developing magnetically controlled radiopaque Fe metallic particles as a radioisotopic radio-contrast agent in dogs in the vascular and lymphatic systems is described. It has also been shown that one can magnetically control radioactive Fe particles in the vascular system. Injection of radioactive and nonradioactive Fe particles directly into healthy animal tissue or irradiated animal tissue results in these Fe particles remaining in the tissue with no appreciable movements. Gross, histologic, and radioisotopic studies show interesting possibilities as to the future use of these particles. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31327 IONIZING RADIATION AND PROFESSIONAL LIABILITY IN DERMATOLOGY. Rees B. Rees (Univ. of California, San Francisco). Arch. Dermatol., 89: 747-8 (May 1964).

The nature of injuries from the use of radiotherapy for skin diseases and the ways in which physicians can protect themselves from malpractice suits resulting from such radiation injuries are discussed. It is suggested that premium for radiotherapy insurance are so high because of the narrow insurance base; not many physicans use radiotherapy. Current outstanding medicolegal hazards, in the order of their importance, it is suggested, are the following: radiotherapy of warts, especially plantar warts; and the use of dual range machines (inadvertently using conventional x rays when grenz rays were intended). Attempts are made to evaluate the incidence of malpractice actions involving radiology as compared with the total. Ten rules are cited whereby malpractice suits from radiation injury can be avoided or reduced in number. (OTS)

31328 COMPARISON OF COINCIDENCE COUNTING AND FOCUSING COLLIMATORS WITH VARIOUS ISOTOPES IN BRAIN TUMOUR DETECTION. C. M. E. Matthews (Hammersmith Hospital, London). Brit. J. Radiol., 37: 531-43(July 1964).

Coincidence counting and focusing collimators with different isotopes are compared for detection of brain tumors with external scanning. A modification of Dewey and Sinclair's figure of merit for the best compromise between resolution and sensitivity for detection of the tumor is measured experimentally using spherical glass bulbs in a tank of water, to represent tumors in the head. The probabilities of detecting tumors of different sizes are calculated for different isotopes making certain assumptions. It is concluded that ^{74}As or ^{72}As with focusing collimators are better than the other isotopes investigated for detection of brain tumors. ^{125}I is not suitable. (auth)

31329 AUTOMATION OF RADIATION TREATMENT PLANNING. IV. DERIVATION OF A MATHEMATICAL EXPRESSION FOR THE PER CENT DEPTH DOSE SURFACE OF COBALT 60 BEAMS AND VISUALISATION OF MULTIPLE FIELD DOSE DISTRIBUTIONS. Theodor D. Sterling, Harold Perry, and Leo Katz (Univ. of Cincinnati). Brit. J. Radiol., 37: 544-50(July 1964).

A formula is presented for approximating the per cent depth distribution resulting from any portal size ^{60}Co beam at 80 cm SSD. This equation may be used to obtain computer printouts of combined multifield dose distributions as described previously (Sterling et al.), or, in a new program, can be used to print out the combined isodose curves directly to scale with small error. A distinct geometric property of the per cent depth dose distribution is discovered and described without attempting to explain it. (auth)

31330 COMBINED USE OF AB-132 (METUREDEPA, TURLOC) AND X IRRADIATION IN THE MANAGEMENT OF ADVANCED BRONCHOGENIC CARCINOMA. Humberto A. Velasco, Charles A. Ross, John H. Webster, Joseph E. Sokal, Leon Stutzman, and Julian L. Ambrus (Roswell Park Memorial Inst., Buffalo and State Univ. of New York, Buffalo). Cancer, 17: 841-9(July 1964).

The effects of combined therapy with carbamic acid [bis

(2,2-dimethyl-1-aziridiyl)-phosphinyl] ethyl ester (AB-132, meturedepa, Turloc), and suboptimal doses of radiation (approximately 35% of the usual dose) were studied in 16 patients with unresectable bronchogenic carcinoma. Objective responses were seen in 14 patients (88%), compared with 7 objective responses in 18 controls (39%) receiving radiation alone. The differences between the two groups in frequency and degree of tumor regression were statistically significant at the 1% level. When radiation was continued in the control group to a total dose of 3000 to 5000 rads, the number of objective responses rose to 14 (78%). Thus, the therapeutic effects of 1800 rads in combination with a course of AB-132 seem comparable to those of 3000 to 5000 rads alone. Toxicity of combined therapy included reversible anorexia, nausea, vomiting, diarrhea, and generalized weakness during therapy, as well as moderately severe but reversible post-treatment leukopenia and thrombocytopenia. AB-132 appears to be a radiation-potentiating agent suitable for clinical use. However, its potential contribution to the treatment of patients with nonresectable neoplasms will have to be evaluated in diseases other than bronchogenic carcinoma, since control of the primary lesion in this disease seems to have relatively little effect on survival. (auth)

31331 DRUGS USED WITH RADIATION IN THE TREATMENT OF CANCER. E. M. Hodnett (Oklahoma State Univ., Stillwater). Cancer Chemotherapy Rept., 32: 55-65(1963).

The uses of drugs to increase the radiosensitivity of cancers are discussed. Results are presented from a literature survey on clinical studies on the effectiveness of various drugs in radiotherapy of cancers. (TCO)

31332 PHYSICAL PLANNING IN RADIOTHERAPY. Jorge Halvas G. and José Telich C. Com. Nacl. Energia Nucl. Mex. [Publ.], No. 164, 101-16(Mar. 1964). (In Spanish)

It was shown that different tumoral zones can be located through x-ray diagnosis. The radiotherapist prescribes a definite dose and it is up to the radiation physicist to set the plans and dosimetry for that dose. (auth)

31333 NEW METHOD FOR REDUCTION OF GONADAL IRRADIATION OF DENTAL PATIENTS. Albert G. Richards (Univ. of Michigan, Ann Arbor). J. Am. Dental Assoc., 65: 1-11(July 1962).

Reduction by ~ one-half the gonadal radiation exposure of the dental patient by use of a suitable x-ray cone is shown. To detect the origin of the offending radiation before taking the necessary measures to control or eliminate the sources, a lead-walled pinhole camera was placed in a position comparable to the lap of the subject with the camera directed upward toward his face and the head of the x-ray apparatus, and exposure was determined. The quantitative influence of various types of dental x-ray cones on gonadal irradiation was also investigated. The head of a cadaver preserved in formalin was used as the subject and the gonadal dose rate was measured with a ratemeter. The smallest gonadal exposure (0.55 mr) was achieved with a short, open-ended, shielded, plastic cone used with x radiation generated at 65 kvp, which is an exceedingly small dose, since every day a person's gonadal region and entire body are exposed to ~ 0.30 mr from natural background radiation. (BBB)

31334 ACUTE (SUB-ACUTE) THYROIDITIS AND ITS TREATMENT BY RADIATION. A. M. Quraishi (Cancer Inst. of Pakistan, Karachi). J. Pakistan Med. Assoc., 13: 397-406(1963).

The condition of acute non-suppurative thyroiditis is described. The etiology is not established, although virus infection and autoimmunological reactions are claimed to be the causal agents. Pathological clinical picture, laboratory investigations and differential diagnosis are described in detail. There are three important aspects of treatment. First, strict bed rest is of paramount importance. Besides this, cortisones would usually help. Radiotherapy is also an extremely useful weapon in bringing about quick recovery. The treatment by radiation is described and two cases are discussed in detail. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31335 DETERMINATION OF THE DOSE OF IONIZING RADIATION IN THE KIDNEY DURING RADIOIODINE THERAPY OF PATIENTS. V. S. Baikova and V. I. Lapchenkov. Med. Radiol., 9: No. 4, 56-62(Apr. 1964). (In Russian)

Measurements of the radiation dose to kidneys during therapeutic procedures with ^{131}I indicated that the ^{131}I uptake by kidneys has a direct relation to the injected dose and a reverse relation to the amount of the dose absorbed by the thyroid and diuresis. The uptake by kidney marrow is 50% higher than by cortex due to urine excretion. With fractionated doses of ^{131}I (every 5 days) the radiation load on the kidneys was only $\frac{1}{4}$th that experienced by patients receiving a single dose of the same amount. Small amounts of ^{131}I produced no obvious morphological changes in the kidneys, however, there is no doubt that certain endocrine alterations and possibly heat-vessel changes take place. The daily diuresis was reduced in patients suffering from thyroid toxicosis and increased in patients suffering from thyroid cancer after ^{131}I therapy. (R.V.J.)

31336 THE DISTRIBUTION OF INTEGRAL DOSES IN THE BONE TISSUE AT THE EXPENSE OF INCORPORATED Ra^{226}. V. M. Malykhin and V. P. Shamov. Med. Radiol., 9: No. 5, 63-9(May 1964). (In Russian)

A method for radiation dose determination using ^{226}Ra uptake is described. Radium content in the organism at the time of observation and radioactivity of excreta are discussed in some detail. (H.M.G.)

31337 NEW LINES FOR RADIOTHERAPY OF CARCINOMA OF THE UTERINE CORPUS. INTRAUTERINE IRRADIATION WITH COBALT-60 BEADS. A. Bocci, A. Tetti, A. Barbanti, and L. Davitti (Università, Turin). Minerva Ginecol., 15: 703-12(1963).

In analogy with packing of the uterine cavity with small Ra needles, ^{60}Co pellets were used for radiotherapy of the uterine carcinoma. This resulted in more homogeneous irradiation. The method was used in 16 patients. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31338 CYTOLOGICAL STUDIES ON PERIPHERAL BLOOD OF THE PATIENTS WITH MALIGNANT TUMOR. 3RD REPORT. ON THE OCCURRENCE OF TUMOR CELLS IN PERIPHERAL VENOUS BLOOD AND THEIR RESPONSE TO RADIATION THERAPY. Hiroshi Asakawa (Tohoku Univ., Japan). Nippon Igaku Hoshasen Hakkai Zasshi, 23: 175-80 (May 1963). (In Japanese)

Blood samples from the antecubital vein of 178 patients with malignant tumors were examined cytologically. Tumor cells were discovered in 40 cases (22.6%), suspicious tumor cells were positive in 26 cases (14.6%), and atypical cells were found in 104 patients (58.9%). In 60 of 178 patients tumor cells were examined twice, before and after radiation therapy. Tumor cells were positive in 13 cases (21.7%) before radiotherapy and remained positive in 9 cases (15.0%) after radiotherapy. The relations between the

occurrence of tumor cells in peripheral blood and the effect of radiation therapy were as follows: (a) In 11 patients whose tumor disappeared after irradiation, circulating tumor cells were negative after radiotherapy. (b) In 26 patients whose tumor was reduced in size by irradiation and in 5 patients whose tumor was not changed by irradiation, no definite relation was obtained. (c) In 11 postoperative patients, tumor cells were always negative before and after radiotherapy. (d) Seven patients became worse after radiotherapy and in 2 of them tumor cells turned positive from negative. The other 5 showed no change. (auth)

31339 A METHOD OF DOSE CALCULATION IN RADIATION THERAPY WITH THE AID OF DIGITAL COMPUTER. Norie Masaki (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 197-204(May 1963). (In Japanese)

A method of obtaining the dose distribution of radiation using an electronic digital computer (NEAC-2203) is developed. By this method, it is possible to determine conveniently, rapidly, and accurately the complete dose distribution for any type of radiation therapy, including interstitial, intracavitary, and external, and for each individual case. A practical method of individual dose estimation for radioactive small-source therapy has become urgent. The actual positions of sources in the body can be determined accurately in three dimensions from stereographic double-exposed radiographs. It is believed that the method can be of value as a routine procedure and solve many problems that arise in daily practice. (auth)

31340 CLINICAL APPLICATION OF FLUOROD DOSIMETRY. Tatsuo Arai (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 753-72(Sept. 1963). (In Japanese)

In radiation treatments, the dose measurement at the lesion is most important. However, the volume of conventional ionization chambers is too large to use for this purpose. In the present paper, clinical uses of the glass fluorod contain Li, Al, B, and Ag, a modification of Schulman's in 1953, are described. In physical aspects, the glass fluorod appears to be more reliable than other dosimeters. The results of the direct tissue dose measurement by the rod when the tongue was treated by a radium needle were in good agreement with the Paterson-Parker's table for the single plane treatment. Tissue correction factors were obtained for the chest cavity from rotation therapy of cancers of the esophagus. The correction factors obtained were 1.4 for the middle part of the esophagus and 1.2 for the lower part for 200-kvp x rays, 1.08 for the middle part for ^{60}Co. Intracavity dose measurements were also made for the esophagus, stomach, and urinary bladder in fixed field treatments. (auth)

31341 EFFECT OF THE DIAPHRAGM ON THE GONAD DOSE. Tadashi Hashizume, Yoshio Kato, et al. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1165-72(Jan. 1964). (In Japanese)

Miyakawa et al. estimated the genetically significant dose from x-ray diagnostic examinations in Japan. They measured gonad doses by using exposure conditions described in sampling survey cards collected during 1959 and found that the observed gonad doses for each exposure condition were distributed over a wide range. In this paper, some causes leading to such distributions are discussed. It was found that the effect of the irradiation field was the most important factor. The dimensions of the radiography diaphragm described in most of the cards were larger than those calculated from focus-film distance and film size, and the gonad dose increased exponentially with increase in the diaphragm dimensions. When the calculated diaphragm dimensions instead of those described in the cards were adopted, the gonad dose decreased considerably and the genetically significant dose was reduced to 64.5 percent of the value estimated by Miyakawa et al. (auth)

31342 THE RED BLOOD CELL UPTAKE OF ^{131}I-TRIIODOTHYRONINE AS A MEASURE OF THYROID FUNCTION. I. CLINICAL RESULTS. Fumio Kinoshita, Yoshio Yonahara, et al. (Okubo Municipal Hospital of Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1179-89(Jan. 1964). (In Japanese)

The red blood cell uptakes of ^{131}I-triiodothyronine were determined in more than eight hundred blood samples since 1960. The uptakes of euthyroid subjects ranged from 11.0 to 17.5 per cent averaging 14.4 per cent in 18 males and from 8.7 to 18.5 per cent averaging 12.4 per cent in 96 females; hyperthyroid subjects ranged from 16.7 to 35.1 per cent averaging 26.7 per cent in 13 males and from 12.5 to 43.3 per cent averaging 22.2 per cent in 87 females; 9 hypothyroid subjects ranged from 3.1 to 9.8 per cent averaging 7.8 per cent; 78 nontoxic nodular and collid goiter subjects ranged from 7.5 to 17.2 per cent averaging 12.3 per cent; 11 malignant goiter subjects ranged from 9.3 to 14.9 per cent averaging 11.9 per cent; 11 subacute thyroiditis subjects ranged from 10.0 to 21.4 per cent averaging 14.6 per cent; 14 chronic thyroiditis subjects ranged from 9.7 to 14.9 per cent averaging 12.0 per cent; and 100 other miscellaneous subjects were determined. In diagnostic studies, 90 per cent of 96 euthyroid females had red blood cell uptakes within the limits 10 to 16 per cent, 94 per cent of 18 euthyroid males within the limits 10 to 17 per cent, 90 per cent of 87 hyperthyroid females above 16 per cent, 92 per cent of 12 hyperthyroid males above 17 per cent, and 9 hypothyroid patients all below 10 per cent. The correlation of the red blood cell uptake of ^{131}I-triiodothyronine with clinical diagnosis, basal metabolic rate, and 24-hour ^{131}I thyroidal uptake was studied. The uptakes of 76 hyperthyroid patients cured after ^{131}I therapy ranged from 7.3 to 17.4 per cent averaging 11.7 per cent. The uptakes of 5 hyperthyroid patients treated with mercazol, 5 hypothyroid patients treated with thyroid drugs, and 4 subacute thyroiditis patients treated with steroid hormone were determined before and after therapy. This test is simple, rapid, inexpensive, and accurate as a measure of thyroid function. This method can be used to eliminate the administration of radioiodine and is more useful for the purpose of following the effects of therapy in various thyroid disorders. Exogenous iodine or thyroid medication do not interfere with this test. (auth)

31343 THE RED BLOOD CELL UPTAKE OF ^{131}I-TRIIODOTHYRONINE AS A MEASURE OF THYROID FUNCTION. 2. METHODS. Fumio Kinoshita, Yoshio Yanahara, et al. (Okubo Municipal Hospital of Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1190-7(Jan. 1964). (In Japanese)

The basic technique of the red blood cell uptake of ^{131}I-triiodothyronine, developed by Hamolsky, was investigated and evaluated to find possibilities for simplifying the technique. The various tracer doses were adopted, but the uptakes were consistent in the range from 0.001 mcg to 0.02 mcg/0.1 cc. The uptake using unstoppered flasks showed lower values than that using stoppered flasks. The periods of incubation were studied for 0.5, 1, and 2 hours. The uptake correlated with the period, but the values of 30-min incubation were also significant in the differential diagnosis

between euthyroid, hyperthyroid, and hypothyroid. The radioactivity remaining in the red blood cell after washing was determined each time. Even the counts after first washing could show significant differences between euthyroid, hyperthyroid, and hypothyroid. The determinations were performed in duplicate, but the results showed no significant differences. The results on stored blood using A. C. D. (within 10 days) were almost the same as those on fresh blood. Correlation between the red blood cell uptake of ^{131}I-triiodothyronine and the hematocrit was seen. From these results it is possible to simplify Hamolsky's technique. According to the possibility of using stored blood this test will become an excellent routine thyroid function test. (auth)

31344 A SURVEY ON HISTORY OF MEDICAL RADIATION IN GENERAL POPULATION IN AICHI PREFECTURE. Takashi Kitabatake, Kozo Morita, et al. (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1282-7(Jan. 1964). (In Japanese)

Questionnaires were sent to 1000 persons selected from the general population in Aichi Prefecture by a two-step random sampling method, to find out whether or not they had a history of any disease treated by radiation therapy or x-ray fluoroscopy. Among the usable responses (869 or 86.9 per cent), 57 or 6.56 per cent had a history of irradiation over three years. The irradiation rate was a little higher in males than in females. Little difference in irradiation rate was recognized in different age groups. In the newly developed city area after War II, there was a high irradiation rate, but the reason is unknown. An analysis of non-responses showed no particular bias in this survey. Details written in English will be published in Nagoya J. Med. Sci. (auth)

31345 RADIOTHERAPY OF CHILD'S PALATINE TONSILS WITH COBALT-60. Etsuo Oka, Tetsuma Igarashi, et al. (Yokohama Keiyu Hospital, Japan). Nippon Iji Shimpo, No. 2051, 23-7(Aug. 1963). (In Japanese)

For radiotherapy of palatine tonsils, 253 children were irradiated by telecobalt and surveyed as to its effectiveness. Further, the side effects of this treatment were investigated. A dose of 800 r was given to 219 ambulatory child patients from 1959 to 1960. The minimizing rate of tonsils was about 60% and improvement of complaints was recognized in 90%. Seventy-nine habitual angina patients from 1959 to 1961 were divided into two groups, and the two groups received doses of 800 r and 400 r, respectively. The effectiveness was somewhat less in the latter than in the former, but both were effective. Twenty patients received irradiation in place of tonsillectomy to prevent recurrence of rheumatic fever, and the results were promising. As to side effects, temporary leucopenia was recognized, but there were no serious side effects. Generally, telecobalt therapy of palatine tonsils is beneficial when the indication is strictly estimated and special protection apparatus is used from the standpoint of radiation safety. (NSA of Japan)

31346 THE CESIUM 137 IRRADIATION APPARATUS AND BASIC DOSIMETRIES. Ichiro Noda (Kyushu Univ., Japan). Onken Kiyo, 15: 213-21(Dec. 1963). (In Japanese)

The utilized beam of the cesium-137 irradiation apparatus was investigated. The outputs, changes of dose rate with field size, etc. were measured. The simple method of measurement used by the author gave satisfactory results. The table of percentage depth dose of the central axis of the field measured by the author was compared with that of H. F. Johns and C. S. Simons et al., and the difference of these two values was not more than 2% in all depths measured. Although ^{60}Co produced better depth dose rate and dose distribution than ^{137}Cs compared with 250-kvp x irradiation ^{137}Cs produced excellent depth dose rate, bone absorption, and skin sparing effect. Some percentage depth dose curves of the central axis and isodose curves in various field sizes at 45 cm source-skin distance are shown. It was concluded that ^{137}Cs telecurietherapy is outstanding for irradiation of malignant tumors, provided that a suitable irradiation method is selected for each individual case. (auth)

31347 THE COMPUTATION OF DOSE DISTRIBUTION IN CERVIX RADIUM TREATMENT. C. S. Hope, Jean Laurie, J. S. Orr, and Judith H. Walters (Western Regional Board, Glasgow). Phys. Med. Biol., 9: 345-57(July 1964).

A digital computer method is described for calculating the dose-distribution in the vicinity of a cervix radium insertion using measured values of the absorption of radium γ rays. Dose rates at specified points and isodose data are produced for any spatial arrangement of tubes. The errors arising in the method and the problems of clinical application are considered. (auth)

31348 THE DANGERS OF DIAGNOSTIC X-RAY EXPOSURE. Russell H. Morgan (Johns Hopkins Hospital, Baltimore). Postgrad. Med., 29: 551-4(May 1961).

To evaluate medical radiation protection measures, available data are examined on the quantitative relation between radiation dose and biologic damage, both genetic and somatic, and on the doses received by persons undergoing x-ray examination. It is concluded that efforts should be instituted to reduce the gonadal radiation dose received by the population. An analysis of the possible deleterious somatic effects of diagnostic x-ray exposure also leads to the conclusion that efforts should be made to reduce this exposure. Recommendations are made for improvements in technique that will lower patient doses. With these precautions it should be possible, it is suggested, to limit average doses for chest films to 0.05 r; for skull films, 0.5 to 1.0 r; for abdominal films, 0.5 to 2.0 r, and for lateral abdominal films 5 to 10 r at the surface of the patient. (BBB)

31349 RADIOGENIC LUNG CANCER. Herman Cember (Univ. of Cincinnati). Progr. Exptl. Tumor Res., 4: 251-303(1964).

The epidemiology of radioinduced lung cancer, particularly as relates to inhaled radioactive particles, is reviewed, and a survey of experimental studies is presented. Results of many of these experimental studies are summarized in a table. The experiments clearly showed that radiation from radioactive materials deposited in the lung is carcinogenic. Experiments with rats, which also have shown that radioactive substances deposited in the lung can lead to pulmonary neoplasia, employed mainly ^{35}S, ^{90}Sr–^{90}Y, and ^{144}Ce to elicit bronchogenic and alveolar cell carcinoma, in addition to several other tumor types. These experiments did not confirm the existence of a unique carcinogenic hazard due to the intense concentration of absorbed energy in the lung tissue immediately surrounding an inhaled radioactive particle. This question of the unique carcinogenic hazard associated with the high absorbed dose gradient around a single radioactive particle deposited in the lung was answered by results of acute $^{35}BaSO_4$ exposure, together with those of the $^{144}CeF_3$ and $^{144}CeCl_3$ exposures. Experiments indicate that the likelihood of inducing lung cancer increases as the volume of irradiated lung tissue increases, that is as the number of radiation foci increase and overlap. Furthermore, the

experimental results imply that the carcinogenicity of a given amount of absorbed radiation energy increases, up to a point, as the absorption of the energy is spread out, both time- and space-wise. Reviewed experimental data includes that realting to carcinogenesis from ^{60}Co, ^{106}Ru, ^{198}Au, ^{210}Po, and ^{239}Pu. (BBB)

31350 CHANGES IN THE CARCINOMATOUS UTERINE CERVIX UNDER THE INFLUENCE OF THERAPEUTIC DOSES OF RADIUM. M. Grgurevic (Univ. of Zagreb). Radovi Med. Fak. Zagrebu, 9: 211-40(1961). (In Serbian)

Macroscopic changes in irradiated cancer tissue visible in cytologic and histologic specimens are described. These nonspecific changes occur after exposure to γ rays and also after other destructive physical and chemical agents have been applied. Normal tissue surrounding the cancer receiving almost the same dose of radiation as the tumor demonstrates similar cell changes as those seen in the cancer. The extent of these alterations can be used as a prognostic sign of successful treatment. The changes in and the terminal appearance of the cancerous cervix uteri after successful treatment with Ra are systematically described and illustrated. (OTS)

31351 A STUDY OF THE FUNCTION OF THE THYROID GLAND BY MEANS OF A DETERMINATION OF RADIOACTIVE IODINE IN THE URINE. B. S. Todorov and Iv. Yonkov. Rentgenol. i Radiol., 3: No. 1, 46-50(1964).

The amount of radioactive iodine excreted in the urine of 22 patients suffering from rheumatic fever was tested over a period of 48 hours and a pronounced reciprocal correlation was found between the activity of the thyroid gland and such excretion. The proportion excreted within 48 hours was 59 to 78% in patients with normal thyroid functioning, 37 to 47% in patients with hyperfunctioning, and 76 to 82% in those with hypofunctioning. The amount was not notably affected by variations in the patients' diuresis. (OTS)

31352 FURTHER MODIFICATION OF THE UTERO-VAGINAL APPLICATOR OF OGIER-SCARPA FOR RADIOTHERAPY OF CANCER OF THE CERVIX UTERI. E. Ogier and R. Renzi (Universita, Florence). Riv. Ostet. Ginecol., 18: 389-402(1963).

Two new types of vaginal apparatus for the endocavitary application of Ra in cases of carcinoma of the cervix uteri are described. They represent the modification of the colpostat of Ogier-Scarpa. The latter has been modified from a mechanical standpoint, the disposition of the Ra sources has been changed, and some Pb screens have been put into the vaginal headpiece. It is thus possible to eliminate some deficiencies and to diminish irradiation of bladder and rectum. The theoretical data on the irradiation doses were experimentally confirmed by dosimetric calculations checked on a water phantom. Data corresponding to the different degrees of divarication of the vaginal ends, with the uterine sound kept at an angle of 90°, are reported. This device is similar to the apparatus of Nolan, inasmuch as the intensity of the dose along the axis shows an analogous behavior in both. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31353 CANCER OF THE MOUTH AND THROAT: THERAPY AND REPAIR. Richard T. Farrior. Southern Med. J., 53: 1021-30(1960).

Treatment of cancers of this region by surgery and radiation is described, and repair of radiation-induced lesions by plastic surgery is illustrated. (BBB)

31354 ISOTOPES IN SURGERY. J. E. Kearns (Northwestern Univ., Evanston, Ill. and Evanston Hospital, Ill.). Surg. Clin. North Am., 44: 75-80(Feb. 1964).

Medical uses of radioisotopes for diagnosis and therapy are briefly reviewed. (C.H.)

31355 THE INTRALYMPHATIC ADMINISTRATION OF RADIOACTIVE ISOTOPES AND CANCER CHEMOTHERAPEUTIC DRUGS. Irving M. Ariel and Michael I. Resnick (Hospital for Joint Diseases, New York and Pack Medical Foundation, New York). Surgery, 55: 355-63(Mar. 1964).

The effects of introducing into a lymphatic vessel various radioactive isotopes as a means of studying distribution patterns of the administered isotopes in the lymphatics and the effects of the intralymphatic administration of radioactive isotopes and cancer chemotherapeutic drugs as treatment modalities are described. It is concluded that the direct introduction of a radiation source or a chemotherapeutic agent offers a theoretically ideal method of destroying cancer in lymph nodes or lymphatics. (auth)

31356 PRACTICAL ASPECTS OF RADIOGRAPHIC CALIBRATION. Neil J. Lyons (Emanuel Hospital, Portland, Ore.). X-Ray Technician, 34: 60-4(Sept. 1962).

A procedure for calibration of x-ray machines used for clinical radiology is described. After verifying the correctness of the timer and the meters used, the actual radiographic calibration of the machine was carried out with a penetrometer made of 11 strips of aluminum each 3-mm thick. These strips were laminated to form a step-wedge by having each layer 0.75 in. shorter than the one below. It was necessary to know how much change in milliampere-seconds or kilovoltage values each step of the penetrometer represents at various kilovolt levels. Once this was established it could be used for adjusting the machine or for adapting the techniques from one machine to another. For the penetrometer used it was found that for all kilovolt ranges a difference in density equal to one layer of aluminum indicates an addition or subtraction of 25% of the milliampere-seconds. As expected, the kilovoltage changes per layer varied with the kilovoltage being tested. For the radiographic calibration a 72-in. focal-film distance was used. By carefully selecting the factors it was possible to determine whether all milliampere stations are consistent and to find out if there is any change in the quality of radiation due to a drop in kilovoltage. After the test films were processed and dried they were cut into strips, each consisting of one penetrometer exposure. The densities of two different milliampere selections were compared by moving the films up or down. The exposures on a correctly adjusted machine would have the same densities. It is recommended that in a 500-bed hospital the equipment be tested at least every six months. (BBB)

CHEMISTRY

General

Refer also to abstract 33063.

31357 (AERE-R-4637) SOLVENT EXTRACTION BEHAVIOUR OF PLUTONIUM CUPFERRATES. II. Pu(IV)-CUPFERRATE. D. M. Kemp (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 14p.

The solvent extraction of Pu(IV)-cupferrate by chloroform is described. It is shown that Pu(IV)-cupferrate is extracted with high efficiency into chloroform at acid concentrations below 1M. The mole ratio of Pu(IV) to cupferron in the extracted complex is probably 1:4. Possible formation of colored intermediate complexes of Pu(IV) with cupferron is indicated. Preliminary results for the solubility product of Pu(IV)-cupferrate are reported. (auth)

31358 (CEA-R-2430) CONTRIBUTION A L'UTILISATION ANALYTIQUE DU PHOSPHOMOLYBDATE D'AMMONIUM: SEPARATION DU RADIO-CESIUM EN SOLUTION. (Contribution to the Use in Analysis of Ammonium Phosphomolybdate — Separation of Radio-cesium in Solution). Jean Scheidhauer, Marcel Chabidon, and Lionel Ordinaire (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1964. 11p.

The analytical use of ammonium phosphomolybdate was studied for the separation of barium from cesium-137. The studies were made on small and medium-sized volumes, and of large volumes of about 100 liters. (auth)

31359 (EUR-1604.f) SUBSTITUTS AUX TERPHENYLES. (Substitutes for Terphenyls). (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. Contract 011-60-12(ORGF). 119p.

The possibility of using petroleum fractions as substitutes for terphenyls as coolants and organic moderators have been studied. During this study, the installation of experimental means and the development of analytical and control methods played an important role, e.g., the apparatus necessary for the preparation of petroleum fractions and for the study of their thermal and radiolytic stability, especially the radiation loop No. 1 in Melusine; dosimetric methods, mass spectrometric, uv and ir analytical methods, analytical methods by activation, and the determination of physical characteristics at high temperature. The main results have been obtained from the study of the characteristics, properties, and composition of three alkylphenanthrene cuts taken from the "residue of catalytic powerforming." The in-pile irradiation of these cuts at 200, 360, and 380° respectively has made possible a preliminary comparison of these products with terphenyl OM2. The experience gained during the development and functioning of the No. 1 loop has been utilized to construct the organic loop No. 2. This loop has been functioning since May 1962, and because of its solidness, simplicity, and dependability, constitutes a tool remarkably adapted to high temperature irradiations of organic fluids. Finally, the realisation of this work has led to the formation of a large team whose experience can be utilized both for studying substitutes for terphenyls and for polyphenyls. (auth)

31360 (UCRL-7797) THE EQUATION OF STATE OF PBX 9404 AND LX04-01. Mark L. Wilkins, Bailey Squier, and Bertram Halperin (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 27, 1964. Contract W-7405-eng-48. 18p. (CONF-605-1)

From 10th International Symposium in Combustion, Cambridge, Eng., Aug. 1964.

The Chapman-Jouguet pressure and equation of state of the high explosives PBX 9404 and LX04-01 have been experimentally derived. To assure a strictly one-dimensional geometry, spheres of high explosives were used. Experimental measurements of the radius-time history of material accelerated by the explosive gases were used in conjunction with finite difference calculations of the hydrodynamic equations to obtain some previous inaccessible data on high explosives. (auth)

31361 (UCRL-11213(p.87-138)) PHYSICAL CHEMISTRY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The topics studied include: activation analysis for C and N, Cm metal, ThI_4, $TbCl_3$, $HgSO_4 \cdot H_2O$, $MnCl_2 \cdot 4H_2O$, XeO_3, $Na_4XeO_6 \cdot 6H_2O$, XeF_4, ion exchange of alkaline earth cations, extraction of $HAuCl_4$ and $HAuBr_4$, large univalent ions, radioinduced reactions of poly-L-glutamic acid and alanine, CO_2 ions, organic mass spectra, triple ionization, molecular beam electric resonance in alkali metal halides, Am(IV) in $LaCl_3$, luminescence of ^{3+}Bk, analysis of atomic spectra, 1^N configurations, quadrupole antishielding in rare earths, isomer shifts, conversion electrons from oriented ^{137m}Ce, polarization of Ag nuclei in Fe and Ni, ^{171}Er, and chemistry of $^{34}S(n,\gamma)$ reactions in gaseous S compounds. (D.L.C.)

31362 (UCRL-11213(p.154-61)) CHEMICAL ENGINEERING. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Desulfovibrio aestaurii was isolated and used in studies of its sulfate reduction capacity. The effects of NaCl and sulfate on the sulfate reduction rate were determined. Correlations are presented for the fluid friction and turbulent exchange rates of mass and heat near the wall region of a pipe. The validity of the addition-of-phase-resistances equation for mass-transfer processes is discussed. The behavior of oscillating jets and the interfacial tension of liquid-liquid systems are discussed. The vapor-pressure behavior of the constituents of aqueous H_2SO_4 is shown over the entire composition range at 25°C. A correlation is given for the nitration rates of 1,3-bis(trifluoromethyl)-benzene by various $HNO_3 - H_2SO_4$ mixtures at 50°C. Studies are described of power requirements for liquid-liquid and gas-liquid agitation in various vessels and of axial mixing (longitudinal dispersion) in packed extraction columns. (D.L.C.)

31363 (USNRDL-TR-745) RADIOACTIVITY RELEASE FROM RADIONUCLIDE POWER SOURCES. I. RELEASE FROM STRONTIUM TITANATE TO SEAWATER. P. E. Zigman, J. L. Mackin, H. Goya, and M. G. Lai (Naval Radiological Defense Lab., San Francisco). Apr. 9, 1964. Contract AT(19-5)-2084. 91p.

The dissolution in seawater of strontium titanate, a SNAP radionuclide fuel which is to contain strontium-90, has been examined. Two series of strontium titanate test specimens containing trace quantities of strontium-85 were used instead of large amounts of strontium-90. The only readily apparent difference between the specimens of the two series was a small difference in density. Dissolution measure-

ments in various solution media were conducted for the most part in the laboratory, and limited tests were carried out in a natural ocean environment. However, primary attention was directed to investigating the behavior of the test specimens immersed in seawater, for which a standard radiostrontium release rate evaluation procedure, using stirred seawater, was established. In addition, the influences on radiostrontium release of altered solution oxygen tension, elevated temperatures, static solutions, and impressed ionizing radiation were evaluated. It was found that regardless of solution media, test specimens released relatively large amounts of radiostrontium during the first day of immersion. Average first-day total release was on the order of 0.2% of initial contained radioactivity. This was equivalent to a dissolution of 800 μg of $SrTiO_3/cm^2$ of test specimen surface. The denser pellets released slightly more radiostrontium at these early times than did their less dense counterparts. Rates of radiostrontium release over several hundred days of immersion did not reach constant values, but decreased monotonically with increasing time. Here, in the long-term release, denser test specimens released less activity. Weighted release data for all tests conducted under standard conditions indicated that long-term strontium titanate dissolution rate, R, is described as a function of time, t (in days), by: $R = 105\ (t + 6)^{-1}\ \mu g\ SrTiO_3/cm^2$ > $(t > 1)$. In the case of specimens immersed in the ocean, release of radiostrontium was low and consistent with results obtained in the laboratory. Change in solution test media did not significantly modify the dissolution rates observed under standard (seawater) test conditions, except in the case of distilled water where an apparent two-fold increase in long-term release was experienced. The impressed conditions had no effect on release observed under standard conditions, except when the surface of an immersed specimen was bombarded with electrons at a dose deposition rate far in excess of that anticipated in the surface of a fully loaded strontium-90 titanate fuel source. Here, however, it wasn't possible to distinguish between ionizing radiation effects and the influence of high specimen temperature. In all laboratory release measurements, it appeared that all of the released radiostrontium remained in solution. On the basis of results obtained in this investigation, it is recommended that more rigorous quality control in titanate production is desirable and that attempts be made to produce very dense pellets; that all titanate fuel be pre-washed to decrease the early release which could occur upon exposure of the fuel; and that long-term investigations of possible alterations of long-term release due to decay of strontium-90 be conducted with fully loaded titanate fuel, using the standard test conditions established in this investigation. (auth)

Analytical Procedures

31364 (A/CONF.28/P/197) ADVANCES IN NEUTRON ACTIVATION ANALYSIS. Vincent P. Guinn (General Atomic Div. General Dynamics Corp., San Diego, Calif.). 13p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The principal areas of improvement in equipment and techniques for neutron activation analysis and applications in the physical sciences are reviewed. Advances have been made in neutron sources of the isotopic type and the small accelerator type. Target lifetimes have been improved by various means. Research reactors with improved facilities for neutron activation work are discussed. Multichannel pulse-height analyzers, counters, and crystal-photomultipliers have been improved. Technique advances are summarized: reactor pulses, reactor fast neutrons, fast radiochemical separations, purely instrumental technique, spectrum stripping, and automation and computer techniques. Recent advances in charged-particle, photonuclear, and prompt-gamma activation analysis are also reviewed. New applications are outlined in petroleum and chemical industries, coal industry, metal and semiconductor industries, pesticide residues, geology and geochemistry, crime detection, space studies, oxygen determinations, and process control and use of stable tracers. 90 references. (T.R.H.)

31365 (CEA-R-2357) CONTRIBUTION A L'ANALYSE PAR ACTIVATION DES GAZ RARES. CONTRIBUTION A L'ANALYSE DE L'OXYDE DE CARBONE ET DE LA VAPEUR D'EAU DANS LES GAZ (THESES). (Contribution to the Activation Analysis of the Rare Gases. Contribution to the Analysis of Carbon Monoxide and Water Vapor in Gases (thesis)). Jean Diebolt (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1963. 48p.

Submitted to Grenoble, France. Université.

Radioactive analysis was applied to the general technique of rare gas separation. This separation is carried out on active charcoal, at constant pressure. The desorption of the gas is caused by an increase in the initial temperature of adsorption. These separations are quantitative and can be confirmed by chemical analysis. The volumes of desorbed gas are measured by radioactive counting. Radioactivation was also used to study the reduction of palladous chloride by carbon monoxide. Since this reduction is quantitative, a knowledge of the mass of palladium reduced can be obtained by measuring its activity. The property of organic chlorides being hydrolysed by water vapor and of liberating hydrochloric acid was used to study quantitatively the amount of water vapor which a gas contains. The hydrochloric acid formed is measured by activation of the chlorine in the acid. (auth)

31366 (CRDC-1193) A FLAMELESS METHOD FOR PRODUCING ATOMIC VAPOUR FOR ATOMIC ABSORPTION SPECTROPHOTOMETRY: DETERMINATION OF CADMIUM. John P. Mislan (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1964. 17p. (AECL-1941)

Described are the design and performance of an atomic absorption spectrophotometer which uses a heated quartz tube instead of a flame for the production of atomic vapor. This instrument combines high sensitivity (detection limit <10 ppb for Cd in H_2O) with operating convenience, particularly for continuous monitoring applications. The basic components are: a Beckman DU monochromator, a photomultiplier detector, a fused quartz tubular absorption cell, two wire wound resistance furnaces (1250°C max.), an atomizer spray-chamber combination, and a d-c powered cadmium hollow cathode lamp. Provision is included for manual optical null or continuous strip chart read-out. Instrument response was determined as a function of furnace temperatures, pressure of atomizing gas (air, argon), spray-chamber and absorption cell dimensions, composition of sample (presence of added anions and cations), and the nature of the solvent (H_2O and D_2O). Limitations are discussed and possible improvements suggested. (auth)

31367 (HW-79194(Rev.1)) DETERMINATION OF A FEW PARTS PER BILLION OF DISSOLVED OXYGEN. A. H. Case (General Electric Co. Hanford Atomic Prod-

ucts Operation, Richland, Wash.). Oct. 1963. Contract AT(45-1)-1350. 16p.

A method is presented which is easily capable of the required oxygen determination sensitivity. The chemical treatment of the sample is that of the standard Winkler method up to the acidification of precipitated manganous hydroxide. Free iodine is then determined spectrophotometrically as the triiodide ion at 350 mμ. Potassium iodate solution is used to prepare a standard curve, eliminating the need for standard oxygen samples. Provision is made to keep the reagent blank at a negligible level. Hydrazine is removed from the samples before analysis by a cation exchange resin column in series with the sampling vessel. (auth)

31368 (HW-82487) DETERMINATION OF WATER IN PLUTONIUM AND URANIUM OXIDES BY ELECTROLYSIS. J. G. Michaelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 28, 1964. Contract AT(45-1)-1350. 11p.

The method described makes possible the measurement of water volatile from fuel material at any temperature up to 800°C in concentrations as low as 1 ppm. Fuel material is heated in a quartz combustion tube through four successive temperature increments up to 800°C. The evolved water is carried by a nitrogen gas stream to a commercial electrolytic water analyzer where the water is absorbed in a phosphorus pentoxide electrolytic cell and is electrolyzed to hydrogen and oxygen. The current used for electrolysis, measured by a strip chart recorder, is proportional to the ppm water evolved over the respective temperature ranges. (auth)

31369 (HW-SA-3461) FLAME SPECTROPHOTOMETRIC DETERMINATION OF CALCIUM AFTER STRONTIUM OXALATE COPRECIPITATION. R. F. Keough (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 26, 1964]. Contract AT(45-1)-1350. 5p. (CONF-606-1)

From American Chemical Society Northwest Regional Meeting, Spokane, Wash., June 1964.

A method is described for the determination of microgram amounts of calcium by a scanning flame spectrophotometric technique. Calcium is readily separated from interfering ions by a preliminary precipitation using strontium oxalate as a carrier. Recoveries from a variety of minerals and biological samples are in the range of 97 to 102 percent. Of the potentially interfering ions examined, recoveries were affected only by phosphate and cations which compete with the calcium and strontium for the oxalate, and then only when present in concentrations hundreds of times greater than that of the calcium. (auth)

31370 (INS-R-27) ACCURACY IN THE DETERMINATION OF THE TRITIUM CONTENTS OF NATURAL WATERS IN THE SOUTH PACIFIC OCEAN AREA, 1959-63, AT THE TRITIUM LABORATORY, INSTITUTE OF NUCLEAR SCIENCES, LOWER HUTT, NEW ZEALAND. C. B. Taylor (New Zealand. Inst. of Nuclear Sciences, Lower Hutt). Aug. 1963. 69p.

An investigation was made of the aspects affecting the accuracy of tritium measurements on natural waters in the Southern Pacific. These aspects include errors in standards, counter F-factors, normalized sample rates, tritium enrichment by electrolysis, deuterium enrichment, overall errors, etc. (D.L.C.)

31371 (KY-429) DETERMINATION OF NEPTUNIUM-237 IN HUMAN URINE. J. A. Miller and G. E. Biggerstaff (Paducah Gaseous Diffusion Plant, Ky.). June 1, 1964. Contract W-7405-eng-26. 16p.

A method was developed for determining ^{237}Np in human urine specimens. The urine is acidified, then concentrated by evaporation. Uranium is removed by a double La fluoride precipitation using ferrous ammonium sulfate and hydroxylamine hydrochloride as reducing agents. Separation from Pu is effected by a thenoyltrifluoro-acetone extraction using potassium iodide–hydrazine or potassium iodide–hydroxylamine to reduce Pu to Pu^{+3} and Np to Np^{+4} The trivalent Pu is not extracted by TTA. Neptunium is stripped from the TTA with HCl and electrodeposited on stainless steel discs from an acid-chloride electrolyte. Recovery of a 200 alpha cpm ^{237}Np spike is 87% ± 8.5% LE_x and of a 1 alpha cpm ^{237}Np spike is 80% ± 26% LE_x. (auth)

31372 (NDL-SP-7) RADIOCHEMISTRY OF PLUTONIUM AND URANIUM IN SOIL. Ralph F. Benck, Robert J. Smith, John Bogdan, Henry Lada, and Henry Mortko (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). June 1964 27p.

Methods for the analyses of trace (microgram) quantities of plutonium and uranium by ion-exchange separation from fission products and soil constituents are presented. The plutonium is measured, either by alpha counting electroplated stainless-steel disks with a thin window counter, or by liquid scintillation counting of the elutant from the ion-exchange step. The quantities of uranium are determined fluorometrically. (auth)

31373 (NP-14007) APPLICATION OF CONTROLLED-POTENTIAL COULOMETRY TO THE DETERMINATION OF URANIUM IN SULFURIC ACID SOLUTIONS. E. Schmid, L. Humblet, and H. Eschrich (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Jan. 1964. 20p. (ETR-162)

Controlled potential reduction of uranium(VI) to uranium(IV) was performed on a mercury cathode in a sulfuric acid medium. The results obtained are presented, and the effect of some common contaminants has been checked. In this method, small amounts of nitrates and chlorides can be tolerated. The optimum precision is obtained with 5 to 10 mg samples, and the per cent standard deviation in this range is 0.2% without any bias. The method is relatively simple and rapid. (auth)

31374 (NP-14008) DETERMINATION OF URANIUM(VI) IN THE PRESENCE OF MOLYBDENUM BY CONTROLLED-POTENTIAL COULOMETRIC REDUCTION. E. Schmid and H. Eschrich (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Feb. 1964. 11p. (ETR-164)

A method for the controlled-potential coulometric determination of uranium in the presence of molybdenum(VI) was checked. Uranium(VI) and molybdenum(VI) are reduced at a very similar potential in 1N sulfuric acid medium. In an alkaline supporting electrolyte the molybdate becomes electrochemically inactive, and does not interfere with the uranium determination as long as the uranium to molybdenum weight ratio is higher than 7 : 1. The uranium is kept in solution by means of a complexing agent. An 0.1M sodium sulfate–0.16M sodium tripolyphosphate mixture was the most efficient. The standard deviation was found to be 0.55% when 4.60 mg uranium(VI) were titrated in the presence of various amounts of molybdate. The influence of various ions on the coulometric determination of hexavalent uranium was also studied. Part of the interfering ions can be eliminated by pre-titration, or by fuming the sample with perchloric acid before titration. (auth)

31375 (AEC-tr-6438) ANALYSIS OF HYDROGEN IN THE FREE STATE OR AS HYDRIDE IN SODIUM. Gerard Naud and Jacques Sannier. Translated for Atomic Power

Development Associates, Inc., Detroit, from Bull. Soc. Chim. France, 2735-7(1963). 9p.

Separation by mercury, already utilized for the analysis of oxygen in sodium, can also be employed for the determination of hydrogen present in this alkaline method in the free state or in the form of hydride. The hydrogen liberated during the amalgamation of sodium or during the hydrolysis of the residue is collected and determined volumetrically; its purity is controlled by chromatographic analysis. The results obtained show that this method permits the analysis for hydrogen concentrations in the order of 0.1 ppm; on the other hand, it permits the introduction of a correction term in the simultaneous determination of the oxygen content of sodium. (auth)

31376 (UCRL-Trans-1053(L)) INCREASING ACIDITY OF BORIC ACID BY ADDITION OF NEUTRAL SALTS. A NEW METHOD FOR QUANTITATIVE ANALYSIS OF BORIC ACID. Harald Schaefer and Adolf Sieverts. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Z. Anorg. Allgem. Chem., 246: 149-57(1941). 18p.

The dissociation of boric acid in solution upon addition of neutral salts is much greater than that of other acids such as acetic acid. Such dissociation was studied by potentiometric titrations, and the order of salts with increasing dissociative effect was found to be as follows: KCl < NaCl < LiCl < $BaCl_2$ < $SrCl_2$ < $CaCl_2$ < $CaBr_2$. Two methods for the quantitative determination of boric acid using $CaCl_2$ are given. (D.L.C.)

31377 A NEW METHOD FOR THE ASSAY OF SMALL AMOUNTS OF RADIOACTIVE IRON (^{59}Fe). W. N. M. Ramsay and Jean V. Fulton (Univ. of Edinburgh). Anal. Biochem., 8: 319-24(July 1964).

A simple procedure is described for the assay of ^{59}Fe by β counting at infinite thinness after precipitation and plating as ferrous dipyridyl mercuriiodide. (auth)

31378 PRECISE MICRODETERMINATION OF COBALT. Robert S. Ondrejcin (E. I. du Pont de Nemours & Co., Aiken, S. C.). Anal. Chem., 36: 937-8(Apr. 1964).

A precise microanalysis scheme based on differential spectrophotometry for the determination of Co at the 2 μg level in Al–Co wire monitors that are used to measure the neutron flux in nuclear reactors is reported. The method provides for improved relative standard deviation of flux measurement data, previously limited to ±6% by the nonuniform distribution of Co in the monitor wire and by the precision of the method of activation analysis. (P.C.H.)

31379 SINE-WAVE POLAROGRAPHIC DETERMINATION OF ZIRCONIUM OR NIOBIUM IN AQUEOUS MEDIA. Motomu Kasagi and Charles V. Banks (Ames Lab., Ames, Iowa). Anal. Chim. Acta, 31: 11-16(July 1964). (IS-796)

The sine-wave polarographic determination of zirconium in aqueous media was investigated using solutions that were 0.55 to 5.5 × 10^{-3} M in zirconyl chloride and 1M in potassium chloride and that were adjusted to pH 2.0 with hydrochloric acid. It was possible to determine zirconium in the concentration range of 0.05 to 0.4 mg per ml. The sine-wave polarographic behavior of zirconium in aqueous solutions in the pH range 2 to 3 is discussed. The sine-wave polarographic determination of niobium in aqueous media was investigated using concentrated sulfuric acid containing 5 to 0.1 mg of niobium per ml in a supporting electrolyte of citric acid; the determination of niobium was possible down to 0.1 mg of niobium per ml of concentrated sulfuric acid although the d-c polarographic method was impractical for the determination of less than 0.5 mg of niobium per ml. (auth)

31380 DETERMINATION OF STRONTIUM COPRECIPITATED WITH BARIUM BY X-RAY EMISSION SPECTROSCOPY. Gerald J. Wonsidler and Robert S. Sprague (Lehigh Univ., Bethlehem, Penna.). Anal. Chim. Acta, 31: 51-7(July 1964).

X-ray emission spectroscopy allowed detection of as little as 0.02% strontium in barium chromate. This method was applied to evaluate the effectiveness of 4 procedures for separating barium and strontium by chromate precipitation. All of the procedures checked require at least 2 precipitations for a satisfactory separation. Of the 4 methods checked, that of Beyer and Rieman is recommended on the basis of convenience and effectiveness of separation. (auth)

31381 ASSESSING THE ACTIVITY CONCENTRATION OF β-EMITTERS BY MEANS OF THE END-WINDOW G.M. TUBE. G. H. Bolt and B. G. M. Pieters (State Agricultural Univ., Wageningen, Netherlands). Anal. Chim. Acta, 31: 64-70(July 1964).

The activity concentrations of β emitters including ^{35}S (0.15 Mev) and presumably also ^{14}C (0.14 Mev) may be determined with satisfactory accuracy using an end-window G-M counter. For single preparations (if weighed), the described procedure warrants that the standard error will not exceed 0.8%, if the amount of substrate is kept below 0.2 mg/cm^2, and if carrier-free solutions are avoided. With a minimum of 4 preparations per sample solution, the error of the mean should not exceed 0.4%. (auth)

31382 AN ISOTOPIC ANALYSIS OF POTASSIUM AND RUBIDIUM USING A THERMAL IONIZATION SOURCE. Wlodzimierz Zuk, Longin Gladyszewski, and Janusz Zinkiewicz. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, Sect. AA, 16: 131-8(1961).

The isotopic composition of potassium and rubidium samples from minerals, plants, and sea water was determined. A 60° mass spectrometer of the symmetrical type was used in the analysis. A thermal-ionization source was used in the spectrometer. From more than 50 measurements of the isotopic composition of potassium, the value of 13.55 ± 0.03 was found for the ratio of peaks ^{39}K : ^{41}K. From more than 100 measurements the ratio of peak heights ^{85}Rb : ^{87}Rb equaled 2.61 ± 0.01. (M.C.G.)

31383 OSCILLOPOLOGRAPHIC DETERMINATION OF URANIUM IN THE PRESENCE OF PHENOLS. Jerzy Matysik. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, Sect. AA, 16: 37-52(1964). (In Czech.)

It was established that uranyl salts in liquid ammonium nitrate-ammonia and in many cases also in aqueous NH_4NO_3–NH_4OH solutions react with organic compounds, which possess a hydroxyl group on the aromatic ring. The products of these reactions have a large oscillographic activity, which neither UO_2^{2+} nor the organic compounds possesses. This phenomenon can be used for qualitative and semi-quantitative detection and determination of uranium. The method is selective, sensitive, simple, and fast. It can also be used in identification of organic compounds reacting with uranium. (tr-auth)

31384 DETERMINATION OF THE MOISTURE CONTENT OF SAND BY MEANS OF THE FAST NEUTRON FLUX ATTENUATION METHOD. V. D. Volovik, G. P. Strelkov, A. S. Cherkasov, and G. N. Chursin. At. Energ. (USSR), 16: 366-7(Apr. 1964). (In Russian)

Using recently developed fast neutron flux detecting methods it was found possible to determine rapidly the moisture content of building materials by measuring the attenuation of the fast flux passing through the material, correlating the data with the H, –i.e. H_2O content. In actual

practice specific counting statistics must be satisfied, in order to avoid the problems caused by the buildup factor. Thus, using sand samples with a total thickness of 14 cm and carrying out the measurements with a 14-Mev source, a change of 4% in the counting rate corresponds to a change of the moisture of about 2.5%. A standard Po–Be source with a flux of 10^8 n/sec and a 100-kev deuteron generator were used for the measurements; the system yielded 14-Mev neutrons on the basis of the T(d,n)^{4}He reaction, at the 1 to 4 · 10^8 n/sec level. A ZnS(Ag) scintillator was used as a detector because of its low pulse amplitude toward γ-quanta, as compared to neutrons. Standard sand was used for the experiments, changing its moisture content from 20 to 0% by drying out the samples to the desired level. It was found that the moisture measurements by the fast-flux attenuation method yields values with an error of less than 2%. (TTT)

31385 CONTINUOUS DETERMINATION OF BORON IN A PROCESS STREAM USING A LOW LEVEL NEUTRON SOURCE. K. Ljunggren and R. Christell (Isotope Techniques Lab., Stockholm). Atompraxis, 10: 259-63(June 1964).

The determination of boron using either neutron absorption measurements or measurement of the gamma radiation from ^{7}Li formed by the reaction ^{10}B(n,α)^{7}Li was investigated with a ^{210}Po–Be neutron source. The possibilities of measuring the concentration of perborate in a synthetic detergent by these methods were studied. (M.C.G.)

31386 THE SENSITIVITY OF RADIOACTIVATION ANALYSIS BY A LOW LEVEL NEUTRON SOURCE. Yuzuru Kusaka, Haruo Tsuji, and Takayoshi Adachi (Konan Univ., Higashinada-ku, Kobe, Japan). Bull. Chem. Soc. Japan, 37: 597-600(May 1964).

Experimental findings on the sensitivities obtained by irradiation and measurement procedures that are designed to be suitable for a routine analysis of all the elements under consideration are described. Results of thermal neutron flux determinations are also included. It was concluded that the data reported should be useful in general radioactivation analysis using a low-level neutron source. (P.C.H.)

31387 FURTHER STUDIES OF THE NEUTRON SHIELDING OF METALS IN THERMAL NEUTRON ACTIVATION. Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 664-8(May 1964).

Neutron shielding of metals in thermal neutron activation was studied in an attempt to ascertain the relationship between the neutron absorption cross section and the weight of each element that brings about an appreciable self-shielding effect, hoping thus to simplify the experimental process. Measurements on the self-shielding effects of Au, Ag, Cu, Co, In, Ga, Sb, Cr, Se, and Sn metals are reported. The relationship obtained between the neutron absorption cross section in barns, σ_{abs}, a and the weight in grams of an element corresponding to a 10% self-shielding effect was found to be W (weight): σ_{abs} xW/atomic weight of sample) ≃ 0.03. The results obtained appear to confirm that this equation is useful in estimating the most suitable amounts of a sample to be used in neutron activation analysis. (P.C.H.)

31388 HIGHLY SENSITIVE RADIOAUTOGRAPHIC TECHNIQUE TO BE USED FOR THIN-LAYER CHROMATOGRAPHY. G. Fray and J. Frey (Faculté de Médecine et Pharmacie, Lyon). Bull. Soc. Chim. Biol., 45: 1201-5 (1963).

A technique is described for the rapid detection of small amounts of ^{14}C-labeled substances on chromatograms. This technique makes possible the detection of amounts of ^{14}C of the order of 0.01 to 0.05 μC/cm^2 with one hour's contact with highly sensitive photographic films developed in such a way as to increase still further their sensitivity. The relation between time of contact and amount of tracer was studied. Excerpta Med., Sect. 23, 1: No. 5, (May 1964).

31389 DETERMINATION OF TRACE IMPURITIES IN HIGH PURITY MATERIALS BY NEUTRON ACTIVATION ANALYSIS. I. THE BEHAVIOUR OF SOME ELEMENTS IN THE COURSE OF ANALYSIS. Halina Jaskólska, Ludmiła Wódkiewicz, and Jerzy Minczewski (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 9: 453-8(1964).

The behavior of As, Sb, Cu, Ga, Mo, Zn, Sn, Au, and In in extraction and separation processes is described. Extraction methods for the elements are also described. Acetylacetone extraction from HCl solution was found to be preferred over H_2SO_4. The results confirmed the importance of previous examination of the behavior of the determined elements in the extraction process and caused some changes in the planned scheme of analysis; Mo cannot be extracted from concentrated HCl solutions because of simultaneous Au and Sb extraction. (P.C.H.)

31390 DETERMINATION OF TRACE IMPURITIES IN HIGH PURITY MATERIALS BY NEUTRON ACTIVATION. II. ANALYSIS OF HCl, HNO_3, AND H_2O_2 FOR SEMICONDUCTOR APPLICATIONS. Halina Jaskólska, Ludmiła Wódkiewicz, and Jerzy Minczewski (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 9: 459-67(1964).

A scheme of analysis is given for the determination of As, Sb, Sn, Au, Mo, Cu, Zn, Ga, and In in semiconductor materials, and high purity materials, such as mineral acids, organic acids, and other chemical compounds. The results of analyses on H_2O_2, HCl, and HNO_3 are described. (P.C.H.)

31391 DETERMINATION OF TRACE IMPURITIES IN ALUMINUM BY NEUTRON ACTIVATION METHOD FOLLOWED BY GAMMA-RAY SPECTROMETRY. Wanda Żmijewska and Danuta Kozmińska (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 9: 469-74(1964).

The determination of Mn, Cu, As, Sb, Ga, Sm, Sc, and Cr impurities in Al by neutron activation followed by gamma spectrometry is described. The sensitivity limits for the method are: 0.01 ppm for Sc; 0.05 ppm for Sm and Mn; 0.1 ppm for Sb; and 0.5 ppm for Cu, Ga, As, and Cr. The results were in good agreement and indicate that the method can be used for the analysis of high purity Al for various industrial applications. (P.C.H.)

31392 STUDIES ON THIOCYANATE METHOD OF NIOBIUM DETERMINATION. [PART] I. Jerzy Minczewski and Cezary Różycki (Technical Univ., Warsaw). Chem. Anal. (Warsaw), 9: 601-10(1964). (In Polish)

The effects of organic solvent on the spectrum of the thiocyanate complex of Nb were investigated. The role of tin chloride is explained, and the optimum conditions of extraction of niobium–thiocyanate complex were determined. The results showed that an addition of CCl_4 to ether extract of the Nb complex decreases the absorbance at absorption maximum, and shifts it towards longer wavelengths. An addition of acetone decreases the absorption value also, shifting the maximum towards shorter wavelengths. It was proposed to use a mixture of ether and CCl_4 (1 : 1) instead of ether. During the investigation of tin chloride on the absorption value of the Nb complex, it was found that the absorption value increases with increase of $SnCl_2$

concentration. $ZnCl_2$ and $SnCl_4$ also have similar influences. (P.C.H.)

31393 RESOLUTION OF THORIUM–IRON AND THORIUM–ALUMINUM SYSTEMS. R. Přibil and V. Veselý (Polarographic Inst., Czechoslovak Academy of Sciences, Prague). Chemist-Analyst, 53: 77-8(July 1964).

The determination of thorium in the presence of iron or aluminum by EDTA titration followed by reaction of the thorium EDTA complex with triethylene: tetraminehexaacetate (TTHA) is described. (M.C.G.)

31394 THE SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. XI. SORPTIVE PROPERTIES OF TIN(IV) HYDROXIDE. S. Sýkora and Z. Kolařík (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Řež). Collection Czech. Chem. Commun., 29: 1350-60(June 1964). (In German)

The sorption of different amounts of Ce^{3+} ions and carrier-free ^{95}Zr, $^{106}RuNO$, and ^{137}Cs on tin(IV) hydroxide was investigated as a function of the hydrogen ion concentration and the absorbent mass. In the case of Ce^{3+} the velocity of the sorption process was also followed. The mechanism of the absorption on tin(IV) hydroxide is identical with ion exchange and conforms to the mass effect law. The absorption of some complexing agents was also investigated. The possibility of modifying the absorption of cations by their presence was tested. (tr-auth)

31395 GRAVIMETRIC DETERMINATION OF TITANIUM AND ZIRCONIUM AND THEIR SEPARATION FROM IRON USING o-DIHYDROXYCOUMARIN. B. D. Jain and H. B. Singh (Univ. of Delhi). Indian J. Chem., 2: 246-7 (June 1964).

Titanium and zirconium form insoluble complexes with 4-phenylesculetin at pH 1.8 to 3.7 and 2.0 to 3.0, respectively, whereas iron (II) does not form an insoluble complex under these conditions. This was made use of in the gravimetric estimation of titanium and zirconium in the presence of iron (II). The complex formed was ignited and the resulting metal oxide weighed. In the absence of interfering ions 4.6 mg of titanium dioxide and 5.3 mg of zirconium dioxide per 200 ml of solution can be estimated. A tentative structure for the complex is suggested. (auth)

31396 ESTIMATION OF $C^{14}O_2$ BY LIQUID SCINTILLATION COUNTING METHOD. G. S. Pande (Univ. of Saskatchewan, Saskatoon). Indian J. Chem., 2: 287-89(July 1964).

A simple and easy-to-manipulate glass vacuum system for collecting and estimating the radioactivity of small amounts of $^{14}CO_2$ by a liquid scintillation method was developed. Results obtained with this system are quite reproducible. However, the efficiency of counting drops with the increasing amounts of hyamine used. (auth)

31397 DETECTION OF VOLUME PARTS PER MILLION OF PERMANENT GASES IN HELIUM. P. J. Bourke, R. W. Dawson, and W. H. Denton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chromatog., 14: 387-404(May 1964).

A technique is described for analyzing volume parts per million (vpm) mixtures of permanent gases in helium using the Lovelock radioactive ionization detector after chromatographic separation. The amounts of all other gases remaining in a carefully purified helium carrier stream were proved, using a liquid helium trap, to be less than 1 vpm (except neon, 5 vpm), varying from 0.03 vpm CO_2 to 0.9 vpm H_2. The accuracy of the technique is specified down to the limits of significant detection, ranging from 0.02 to 0.5 vpm. (auth)

31398 THE DETERMINATION OF PLUTONIUM BY A. C. POLAROGRAPHY. G. W. C. Milner and A. J. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electroanal. Chem., 7: 190-205(Mar. 1964).

A method is described for the determination of plutonium in the range 4×10^{-6} to 4×10^{-4} M by a-c polarography. It is based on a peak at −0.42 v vs a mercury pool anode from a citrate supporting electrolyte (pH 4.5). This peak is produced by plutonium in either the trivalent or the tetravalent state, due to the reversibility of the Pu^{4+}/Pu^{3+} couple. Spectrophotometry showed that the tetravalent plutonium–citrate complex is more stable than the trivalent complex, which oxidizes to the tetravalent state. The peak for tetravalent plutonium is preferred for analytical work, but interference can be caused by some elements, especially iron. An ion-exchange procedure was developed for the separation of plutonium from interfering elements. This method was applied to the determination of the plutonium contents of uranium–plutonium alloys containing 0.25 to 1.0% of plutonium. (auth)

31399 THE POLAROGRAPHIC ESTIMATION OF THORIUM USING SOLOCHROME VIOLET R.S. IN ALKALINE MEDIA. Donald S. Turnham (Colchester and N.E. Essex Technical Coll., Colchester, Essex, Eng.). J. Electronal. Chem., 7: 211-17(Mar. 1964).

An estimation of thorium in dilute solutions (0 to 0.6 mM) is described. A solution of 0.546 mM solochrome violet R.S. (the sodium salt of 5-sulfo-2-hydroxy-α-benzene-azo-2-naphthol) is used in 0.1 M sodium potassium tartrate solution at pH 12.0 as supporting electrolyte, and methyl cellulose (0.002%) as maximum suppressor. The height of the dye reduction wave is inversely proportional to thorium concentration, while that of the dye–thorium complex reduction wave is proportional to thorium concentration. Either wave height may be compared with a previously prepared calibration graph. (auth)

31400 A NEW SERIES OF SYNTHETIC ACID STABLE MINERAL ION EXCHANGERS. I. FERROCYANIDE–MOLYBDATE (FeMo). D. Huys and L. H. Baetslé (Belgian Nuclear Research Center, Mol). J. Inorg. Nucl. Chem., 26: 1329-31(July 1964).

The precipitate from a mixture of molybdate and ferrocyanide was found to possess particularly attractive properties for use as an ion exchange material. On mixing sodium molybdate in HCl solution with $H_4Fe(CN)_6$ a precipitate is obtained if the final ratios of H/Mo and Mo/Fe are higher than 2; below this ratio the efficiency of the precipitation is very poor. The product is reasonably stable in acids up to 0.2 M HCl and HNO_3, but is slowly attacked at higher acidities. A reducing medium helps to keep the material stable even in the presence of 2 M acid. The practical value of the new compound for the separation of fission products is demonstrated by the fact that Cs may be removed from concentrated reprocessing waste solutions. (P.C.H.)

31401 A METHOD OF MEASURING THE CONTENT OF RADON IN WATER SOLUTIONS BY RADIATION WITH THE AID OF STATIONARY RADIOMETRIC APPARATUS. S. V. Andreev (Central Inst. of Physiotherapy, Academy of Sciences, USSR). Med. Radiol., 9: No. 4, 47-51(Apr. 1964). (In Russian)

A highly productive radiometric method for determining the radon content in solutions by gamma radiation of its daughter products is reported. With the aid of standard apparatus (wave-radiometer with a lead case made from standard lead units) the method enables the content of radon in water and other liquids to be determined in sealed cap-

sules within the following limits: with the use of capsules-syringes—from $0.36 \cdot 10^{-10}$ to $0.7 \cdot 10^{-10}$ C/ml with an error up to ±10%, and from $0.7 \cdot 10^{-10}$ C/ml and higher with an error not exceeding ±5%; with the use of special capsules—from $0.9 \cdot 10^{-11}$ to $1.8 \cdot 10^{-1}$ C/ml with an error up to ±10%, whereas from $1.8 \cdot 10^{-11}$ C/ml and higher with an error less than ±5%. (auth)

31402 NON-DESTRUCTIVE ACTIVATION ANALYSIS OF METEORITES. David E. Fisher (Cornell Univ., Ithaca, N. Y.). Meteoritics, 2: 137-9(Feb. 1964).

Gamma spectrometry was used as a substitute for chemistry in the activation analysis of meteoritic specimens. After irradiation, instead of dissolving the sample and chemically extracting particular elements, the sample was instead placed in a scintillation counter and its gamma spectrum analyzed with the aid of a multichannel analyzer. By a suitable choice of irradiation conditions, various nuclides could be made to stand out clearly against the background of the irradiated meteorite. As examples, data are presented for aluminum and fluorine analysis of chondrites. (auth)

31403 INDUSTRIAL APPLICATIONS OF BETA-RAY EXCITED X-RAYS. XI. NEW APPARATUS FOR X-RAY SPECTROCHEMICAL ANALYSIS. Shigemasa Enomoto and Chizuo Mori (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku, 13: 24-30(Jan. 1964). (In Japanese)

The performance of a newly devised apparatus for x-ray spectrochemical analysis using a beta-ray source was investigated. The x rays emitted from the sample materials by ^{147}Pm beta irradiation are detected with a proportional counter of $Ar-CH_4$ gas-flow type or $Xe-CH_4$ gas-sealed type. The backscattered beta rays are removed from the x-ray path by magnetic deflection. The materials, packed in vessels and placed on a table in the sample chamber of the apparatus, are easily set in front of the source by a manual operation. As the pressure in the x-ray or beta-ray path is adjustable to 0.25 ~ 0.1 mmHg of air, the soft x-rays from light elements in the samples can be determined with the gas-flow counter. As there is less absorption of x-rays or beta-rays, the intensity of the x-rays is increased with the decrease of pressure in the radiation path and ^{147}Pm beta-ray excitation produces an adequate intensity of K x rays from specimens of Al to Mo. (auth)

31404 NEUTRON ABSORPTION ANALYSIS OF BORON ORES USING THE SCINTILLATION APPARATUS RAP-2M (NEUTRON). G. V. Ostroumov. Razvedka i Okhrana Nedr, 29: No. 9, 40-5(1963). (In Russian)

A neutron absorption analysis method using scintillation apparatus was tested on many ore samples of sedimentary origin containing boric oxide (0 to 4.2%) and chlorine (5 to 56%). Results for boron and chlorine are tabulated. Although the method is useful for boron detection in solutions, it is not effective in mineral waters. (H.M.G.)

31405 A BASIC STUDY ON THE APPLICABILITY OF GAMMA-RAY BACKSCATTERING TO AUTOMATIC DISCRIMINATION OF COAL AND ROCKS. K. Matsuguma, S. Oba, and I. Takiguchi. Saikō to Hoan, 9: 451-8(Sept. 1963). (In Japanese)

Samples of 3 types of coal and 6 kinds of rocks with dimensions of over 15 cm thick, 20 cm long, and 15 cm wide each were irradiated using a ^{60}Co or ^{137}Cs gamma source. Then the backscattered rays from the samples were analyzed by a single-channel scintillation γ spectrometer. In the case with the ^{60}Co source, the sandstones showed 1.2 to 1.4 times greater backscattered rays than that of coals. The most effective discrimination energy range between coal and rock was between 0.10 to 0.15 Mev. The ^{60}Co was a more adequate irradiation source than ^{137}Cs. The surface condition of both coal and rock did not affect greatly the backscattered counting rate. (OID)

31406 ACCURACY OF BONE MINERAL MEASUREMENT. Richard B. Mazess, John R. Cameron, Richard O'Connor, and David Knutzen (Univ. of Wisconsin, Madison). Science, 145: 388-9(July 24, 1964).

The use of nearly monochromatic radiation (^{125}I) for the direct determination of bone mineral absorption in cadaver materials indicates that underlying bone components can be measured accurately on the flesh-covered forearm. The correlation of the bone mass, determined by this scanning technique, with actual bone weight is 0.96. The method is the most accurate yet demonstrated for bone with overlying tissue, and may prove suitable for these studies in vivo where it has not been possible to use previous roentgenologic techniques. (auth)

31407 MAGNETRON TYPE MASS SPECTROMETER. Shigeru Nakagawa (Inst. of Physical and Chemical Research, Tokyo). Shitsuryo Bunseki, 11: 89-93(Oct. 1963).

A small and simple mass spectrometer was constructed, which utilized the magnetron characteristics of cutting off the ion currents successively according to their masses by scanning the magnetic field. The isotopic contents of lithium were analyzed using the center filament as a surface ionization source. By superimposing a small a-c voltage on a constant accelerating voltage, stepped ion currents collected on the outer cylindrical electrode were modified and a conventional mass spectrum was recorded. (auth)

31408 RADIOACTIVATION ANALYSIS. D. Stevancevic. Tehnika, 18: 2197-2204(Dec. 1963). (In Serbo-Croatian)

The principles, present stage, and basic trends in the development of radioactivation analysis, and the main advantages and limitations of this method are discussed. Applications of radioactivation analysis in purity control are reviewed, especially for nuclear and semiconductor materials. Several examples of the application of the method in oceanography, geology, and medicine are given. (OID)

31409 SPECTROGRAPHIC DETERMINATION OF ZIRCONIUM IN SOLUTIONS DURING ANALYSIS OF NICKEL AND ITS ALLOYS. Z. I. Ivanova, T. V. Tsyvenkova, and P. N. Kovalenko (Rostov-on-Don State Univ., USSR). Ukr. Khim. Zh., 29: 755-8(1963). (In Russian)

A spectrographic analysis was made of zirconium in nickel-containing solutions. The sensitivity of the method is 5×10^{-5} mole/l or 0.0004%. The effects of acidity and of sodium and iron salts on the determination of zirconium were also estimated. The best results were obtained with solution of pH 1 to 2. The method is efficient for determining zirconium in acid and in magnetic alloys and for zirconium salt analysis. (R.V.J.)

31410 SEPARATION OF RARE EARTH IN THE PRESENCE OF OTHER ELEMENTS. G. Ya. Gornyi and E. F. Gavrilova (Inst. of Geology, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 29: 859-63(1963). (In Russian)

A new variation was developed for the oxalate separation of small amounts of rare earths in the presence of large quantities of other elements. The method is based on the principle of neutralization of oxalate complexes by calcium carbonates. The method is effective for the separation of rare earths in the presence of any predominating elements. (R.V.J.)

31411 REAGENTS FOR THE COLORIMETRIC DETERMINATION OF TANTALUM. A. K. Babko and M. I. Shtokalo (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 220-3(1964). (In Russian)

The color intensity of Ta, Nb, and Ti complexes were studied as a function of pH of a solution with a group of selected reagents. Morin and hematoxylin are used for determining Ta and Nb and pyrocatecholviolet for Ta in the presence of Nb. (R.V.J.)

31412 DETERMINATION OF CESIUM-137 IN FOOD ASH. A. Montag (Chemische Landesuntersuchungsamt Nordrhein-Westfalen, Munster, Ger.). Z. Lebensm.-Untersuch.-Forsch., 123: 293-300(1963). (In German)

A method for the determination of ^{137}Cs in food ash was described. Because of the use of large ash masses of 10 to 20 g, low specific activities can be detected. A photometric cesium yield determination is added to the γ spectrometric measurements which yields a necessary correction factor for routine determinations. The calibration curve for the photometric determination was formulated with labeled cesium. (tr-auth)

31413 SPECTROPHOTOMETRIC TITRATION OF ZIRCONIUM WITH A SOLUTION OF ARSENZAO III. N. V. Melchakova, M. N. Stanislavskaya, and V. M. Peshkova (Moscow State Univ.). Zh. Analit. Khim., 19: 701-4(1964). (In Russian)

A study was made of the direct spectrophotometric titration of zirconium with a solution of arsenazo III in a medium of 2 and 6N $HClO_4$. The developed method was used for zirconium determination in magnesium and aluminum alloys. (auth)

31414 SPECTROPHOTOMETRIC METHOD FOR DETERMINING THE pH OF THE INITIAL DISSOLUTION AND PRECIPITATION OF DYSPROSIUM HYDROXIDES. P. N. Kovalenko and K. N. Bogdasarov (Rostov-on-Don State Univ., USSR). Zh. Prikl. Khim., 37: 735-41(Apr. 1964). (In Russian)

A spectrophotometric method was used for determining small amounts of Dy separated from dysprosium hydroxide treated by arsenazo at various pH and concentrations. Arsenazo and dysprosium formed a complex compound with 1:1 ratio and an extinction coefficient of 3.054×10^4 and dissociation constant of 1.575×10^{-6}. The pH of the initial stages of $Dy(OH)_3$ dissolution and precipitation almost coincide at 5.94 and 5.95 to 6.0. The activity of $Dy(OH)_3$, determined by the dissolution method is 1.25×10^{-28} and by the precipitation method 1.9×10^{-28}. (R.V.J.)

31415 APPARATUS FOR BETA-GAMMA-PHOTOMETRY. Karl-Heinz Waechter, Hermann Dreiheller, and Franz Stroehlein (to Frieseke and Hoepfner). German Patent 1,167,063. Apr. 2, 1964. Filed Mar. 22, 1961.

The apparatus consists of two rotable discs provided with grooves. The grooves of one of the discs contain samples of the material to be assayed and the grooves of the other disc are for containment of different radionuclides. The discs are mounted on the apparatus in such a way that by rotation of the discs a radionuclide and a sample may be brought into vertical alignment with the receptor for the detector. (Gmelin Inst)

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Refer also to abstracts 31694, 31699, 32302, 32482, and 32879.

31416 (AERE-R-4588) DESIGN OF AN ADIABATIC CONTROL FOR A GRAPHITE CHANNEL OXIDATION RATE EXPERIMENT. R. J. Moulton and E. Lyall (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 26p.

This report describes the design, construction, and testing of a low inertia heater and heat flow control which were developed for use in graphite oxidation experiments. The equipment is suitable for use in a single block type of experiment in which the mechanism of the oxidation is studied, or in the type of experiment in which the approach to runaway conditions in a simulated reactor channel is investigated. The high sensitivity and convenient temperature averaging properties of a thermopile are used to give a very close approach to adiabatic conditions for a graphite block. With a block 4 in. in diameter and 5 in. long held at 450°C, the control arrangement limited the net heat flow to less than 0.13 watt, which would correspond to a temperature drift of 0.16°C/hr. (auth)

31417 (AWRE-O-22/64) THE THERMAL STABILITY OF METAL HYDRIDES. PART 1. RARE EARTH AND YTTRIUM HYDRIDES AND DEUTERIDES. P. M. S. Jones, J. Southall, and K. Goodhead (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). June 1964. 27p.

Dissociation pressure isotherms were obtained for the Ho-H_2, Er-H_2, Tm-H_2, and Lu-H_2 systems. Plateau dissociation pressures were determined for Pr-H_2, Tb-H_2, Dy-H_2, and the deuterides of all these metals plus yttrium. The results show that the stability of the rare earth dihydrides increases to a peak at Dy-Ho-Er and thereafter decreases again to Lu. The strength of the metal-hydrogen bond varies with atomic number in the same manner, as indicated by the changes in the heat and entropy of formation. (auth)

31418 (CEA-R-2398) ÉTUDE THERMODYNAMIQUE DE L'HÉMIOXYDE DE SOUFRE PAR SPECTROMÉTRIE DE MASSE (THÈSES). (Thermodynamic Study of Sulfur Hemi-Oxide Using Mass Spectrometry (thesis)). Robert Hagemann (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1964. 66p.

Submitted to Paris. Université.

The action of oxygen on sulfur, at low pressures, in a high frequency discharge has been studied by continuous mass-spectrometric analysis of the reaction products. The mass spectra of the gases produced by the discharge correspond to a mixture of SO_2, S_2O, S_2, and O_2. Up to 75 per cent of S_2O was measured in the $SO_2 + S_2O$ mixture. It is concluded that the molecules S_2O_2 and SO are not present in the mixture. The ionization potentials of the molecules and the potential required for the appearance of ion fragments in the gas discharge mixture have been studied by mass spectrometry. The heat of formation of S_2O has been estimated using the appearance potentials of the SO^+ ions coming from SO_2 and S_2O. (-18.5 kcal/mole $< \Delta H_f(S_2O_2) < -7$ kcal/mole). The ionization potentials of the molecules S_2, S_4, S_6 and S_8 were measured which are respectively as follows: 9.7 ± 0.1 ev, 10.4 ± 0.5 ev, 8.5 ± 0.3 ev, and 7.3 ± 0.3 ev. Finally the equilibrium for the formation of S_2O from sulfur and SO_2 in a hot filament reactor was studied. The measurement of the variation, between 1100°K and 1500°K, of the equilibrium constant for the reaction: $SO_2 + \frac{3}{2} S_2 \rightleftharpoons 2 S_2O$ has made it possible to determine the enthalpy change of this reaction. (ΔH = 5310 + 370 cals.) The sum of the states of the S_2O mole-

cule, Z^0, has been calculated from the literature data. By applying to the S_2O formation equilibrium the equation: $\text{Log } K_p = \Delta\log (Z^0/N) - (\Delta H_0^0/RT)$ it has been possible to calculate the enthalpy of the reaction at absolute zero ($\Delta H_0^0 = 4780 \pm 60$ cal/mole). Taking into account the specific heat integral between 0°K and 1300°K, the values obtained by this method and by using Van't Hoff's law are in good agreement. The work concerning the heat of formation of SO was also examined to discover whether the formation of SO is possible between 1000°K and 1500°K starting from sulfur and SO_2. (auth)

31419 (CONF-117-45) THE H_2-D_2 EXCHANGE REACTION. I. $^3P_1$ Hg PHOTOSENSITIZED. H. Niki and Gilbert J. Mains (Carnegie Inst. of Tech., Pittsburgh). [1963]. Contract [AT(30-1)-1825]. 24p.

From American Chemical Society 145th National Meeting, New York, Sept. 1963.

The kinetics of the $^3P_1$ Rg photosensitized H_2-D_2 exchange is described by the differential rate law, $d(HD)/dt = A-k(HD)$. The photostationary constant, $Q_\infty = (HD)^2/(H_2)(D_2)$, at 25° is a function of initial H_2/D_2 ratio, the total pressure in the range 0.2–30 cm and surface to volume ratio, and is larger than the equilibrium constant, K. Initial rate studies of the forward reaction at 25° as a function of H_2-D_2 pressure indicate the exchange reaction to occur via both a heterogeneous and a homogeneous mechanism. Initial rate data for HD formation are shown to be consistent with a heterogeneous combination of atomic hydrogens in competition with a reversible homogeneous chain mechanism. At 25° and 1 cm H_2-D_2 pressure, 80% of the HD is formed on the walls; at 25° and 30 cm H_2-D_2 pressure, the wall reaction accounts for 15% of the HD. Q_∞ is shown to approach K as both the temperature and pressure are raised. The mechanistic implications of these observations are discussed. (auth)

31420 (GAT-T-808) CHEMICAL PROPERTIES OF NITROSYL HEXAFLUOROURANATE(V). J. R. Geichman, L. R. Swaney, and P. R. Ogle (Goodyear Atomic Corp., Piketon, Ohio). Sept. 3, 1963. Contract AT(33-2)-1. 9p. (CONF-409-3)

From American Chemical Society 138th Meeting, New York, Sept. 1960.

Some reactions of nitrosyl hexafluorouranate(V), $NOUF_6$, with oxidizing and reducing agents are presented. The oxidation reactions produce hexavalent uranium, while the reduction reactions produce tetravalent uranium. The replacement reaction of various Lewis acids with $NOUF_6$ dissolved in anhydrous hydrogen fluoride is reported. The preparation of some new compounds of pentavalent uranium by double replacement reactions with solid $NOUF_6$ or with solutions of $NOUF_6$ in anhydrous hydrogen fluoride or 48% hydrofluoric acid is described. The compounds $LiUF_6$, $NaUF_6$, $AgUF_6$ and $Ca(UF_6)_2$ result from this preparative method. (auth)

31421 (HW-SA-3148) PREPARATION AND PROPERTIES OF CERIUM(IV) PEROXY ACETATE. C. G. Warren (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 9, 1963]. Contract AT(45-1)-1350. 11p.

Cerium(IV) peroxy acetate, $Ce_2(O_2)_3(C_2H_3O_2)_2$, was precipitated from an aqueous solution containing acetic acid, sodium acetate, cerium(III) nitrate, and hydrogen peroxide. The compound was unstable and decomposed from an original ratio of 1.5 peroxide groups per cerium atom to a ratio of 0.75 in 69 hours. (auth)

31422 (HW-SA-3505) SPECTROSCOPIC DETERMINATION OF EQUILIBRIUM CONSTANTS. W. D. Felix (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 29, 1964. Contract AT(45-1)-1350. 8p. (CONF-606-2)

From American Chemical Society Northwest Regional Meeting, Spokane, Wash., June 1964.

A method for the calculation of equilibrium constants and specific absorptivities from spectrophotometric data is presented for a general complex ion system, $D^+ + A^- = DA$. Calculations are made from experimentally determined absorbances of solutions at a number of different concentrations of the non-absorbing ion, D^+. (auth)

31423 (JEN-126) PREPARACION DE DIOXIDO DE URANIO. I. PRECIPITACION DE PEROXIDO DE URANIO. (Preparation of Uranium Dioxides. I. Precipitation of Uranium Peroxide). J. Alonso, E. Aparicio, J. Arroyo, L. Gerboles, F. Lora, and R. R. Solano (Spain. Junta de Energia Nuclear, Madrid). 1963. 33p.

The precipitation of uranium peroxide from pure uranyl nitrate solutions has been studied. The best recovery and filterability are obtained by precipitation at constant pH = 2.0 Neither free acidity nor washing of the precipitate have any influence on the composition. Precipitations carried out at room temperature and constant pH (0.2–2.5) always produce, regardless of the uranium concentration of the solution, $UO_4 \cdot 4H_2O$. This product has a crystalline structure which is stable at room temperature; if it is kept at 100°C the hydrate described by Watt is formed. On heating the tetrahydrate, the dihydrate appears and both phases coexist until a critical point is reached above which the only structure present is that of the dihydrate. The dihydrate is stable at room temperature even when in contact with water. (auth)

31424 (KFK-197) UBER TERNARE OXIDE DES 3- BIS 7-WERTIGEN TECHNETIUMS MIT ALKALIEN. (On the Ternary Oxide of 3- to 7-Valent Technetium with Alkalis). Basil Kanellakopulos (Kernforschungszentrum. Institut fur Radiochemie, Karlsruhe, Germany). Feb. 1964. 73p.

The systems Li–Tc–O and Na–Tc–O were investigated by chemical and x-ray methods. The compounds of the 7-, 6-, 5-, 4-, and 3-valent Tc with Li_2O and Na_2O were identified, and crystallographic properties of many of them were determined. The behavior of Tc was compared with the behavior of the other elements of its subgroup. The analytical methods used for determination of Tc and the oxidation value are described. (J.S.R.)

31425 (LADC-5905) VAPOR PRESSURES OF TRITIUM OXIDE AND DEUTERIUM OXIDE. INTERPRETATION OF THE ISOTOPE EFFECT. W. M. Jones (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 30p.

Measurements are reported on the difference in vapor pressures of H_2O and T_2O (264 to 387°K) and of H_2O and D_2O (277 to 387°K). The relative vapor pressures of the pure liquids are represented by $\ln (p_{H_2O}/p_{T_2O}) = (-103.87 \pm 0.57)/T + (46480 \pm 210)/T^2$ and $\ln (p_{H_2O}/p_{D_2O}) = (-70.87 \pm 0.43)/T + (33630 \pm 160)/T^2$. The boiling points of T_2O and D_2O are 101.51 and 101.42°C. Isotopic differences in heats of vaporization are given from 10 to 120°C and triple point temperatures and pressures are summarized. The vapor pressure crossover temperatures are D_2O-T_2O, 116.2 ± 0.5°C; H_2O-T_2O, 190 ± 10°C (estimated); and H_2O-D_2O, 220.7 ± 0.1°C (previously determined). Estimates of the parameters in the above equation for H_2O-D_2O, using Raman and inelastic neutron scattering spectra and Bigeleisen's formulation of the vapor pressure isotope effect, agree satisfactorily with the experimental values.

Ratios of corresponding parameters in the above two equations agree with theory. (auth)

31426 (LADC-6274) AN UNCONFINED LARGE-VOLUME HYDROGEN–AIR EXPLOSION. Roy Reider (Los Alamos Scientific Lab., N. Mex.); Harry J. Otway, and Herbert T. Knight (Los Alamos Scientific Lab. Nuclear Rocket Development Station, Jackass Flats, Nev.). [1962]. Contract [W-7405-eng-36]. 28p. (CONF-552-1)

From 53rd National Meeting of the American Institute of Chemical Engineers, Pittsburgh, May 1964.

An examination of the damage caused by the explosion demonstrates that the negative phase of the shock wave appeared to be about half the magnitude of the positive phase. A reasonable engineering estimate places the overpressure at about a half pound per square inch and the amplitude of the negative phase at about a quarter of a pound per square inch. The possibility of so called "molecular collapse" has been considered. This is where the water product of the hydrogen oxidation is so much denser than hydrogen itself that the volume of combustible products is caused to shrink rapidly thus creating the high negative phase. This has been discounted largely because of the presence of large quantities of nitrogen (2 moles per mole water vapor). An excessively great amount of work must be done on the nitrogen to cause this rapid shrinkage in such a short time. Perhaps the most interesting conclusion to be drawn from this experience is that out of some 2,000 pounds of unburned hydrogen exhausted during this run, only about 200 pounds contributed to the explosion. This may tend to indicate that there is no great problem in exhausting a large quantity of hydrogen into the atmosphere. In this case, obviously, a large percentage of the hydrogen exhausted was too diluted to participate in the explosion. It should be noted that a factor in the explosion is the high discharge velocity of the hydrogen which is estimated at about 4,000 feet per square second at the 120 pound per second flow rate. This probably aids considerably in the dilution process. (auth)

31427 (ORNL-P-14) A SIMPLE QUASI REFERENCE ELECTRODE ... APPLICATIONS IN CONTROLLED-POTENTIAL POLAROGRAPHY AND VOLTAMMETRY AND IN CHRONOPOTENTIOMETRY. D. J. Fisher, W. L. Belew, and M. T. Kelley (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 44p. (CONF-599-1)

From the 3rd International Congress of Polarography, Southampton, Eng., July 1964.

The quasi reference electrode (Q.R.E.) is a bright platinum wire or other inert conductor immersed directly in the solution; it may have a very small area. It is used instead of a true reference electrode but must be used with potentiostatic or other circuits that prevent the drawing of cell current through the Q.R.E. When used in appropriate situations, the results obtained by use of a Q.R.E. are like those obtained with a true reference electrode except for the lack of thermodynamic meaning of the Q.R.E. potential; hence, this simple electrode is called a quasi reference electrode. A number of successful applications of the Q.R.E. are described for controlled-potential polarography and voltammetry and for chronopotentiometry in aqueous, organic, and molten salt solvents. For example, the form of polarographic waves is conventional except for the lack of meaning of the observed $E_{1/4}$. The Q.R.E. is convenient to use, simple to construct, rugged, small, does not introduce impurities, can be used in corrosive solutions, will operate at high temperatures, and has a very low resistance. The Q.R.E. is used instead of a true reference electrode when the quantity of interest is the change in emf between the working electrode and the electrode used as reference or the change in current at a constant or scanned applied cell voltage as a function of concentration or some other variable. The predominant consideration leading to the choice of a simple rather than a true reference electrode is the relative convenience of use of these electrodes. The Q.R.E., like other simple electrodes, is not meant to compete with true reference electrodes if they are necessary are available and equally convenient to use. (auth)

31428 (TID-20898) FLAMMABILITY OF DEUTERIUM IN OXYGEN–HELIUM MIXTURES. Final Report No. 3920. Aldo L. Furno, Samuel R. Harris, and Michael G. Zabetakis (Bureau of Mines, Pittsburgh). June 15, 1964. Contract AT(38-1)-336. 12p.

The limits of flammability of D_2–H_2–He mixtures determined at 0.5, 1.0, and 2.0 atm and at 25 and 80°C. The limits were found to be approximately independent of pressure and temperature. The lower limit was ~7.6 vol % D_2 for all He concentrations, while the upper limit was determined by the equations U (vol % D_2) = 96 – [He], where 60 < [He] < 88 vol %, and $[O_2] \cong 4$ vol %. Maximum explosion pressures and pressure rise rates were also measured for several D_2–O_2–He mixtures. (D.L.C.)

31429 (UCRL-7265-T) HEAT-OF-SOLUTION AND VOLUME STUDIES OF METAL–AMMONIA SOLUTIONS. Stuart R. Gunn (California. Univ., Livermore. Lawrence Radiation Lab.). July 31, 1963. Contract W-7405-eng-48. 21p. (CONF-575-1)

From the Proceedings of Colloque Weyl, Lille, June 1963.

A low-temperature calorimeter that was developed for the studies is described. The heat of solution of Na in NH_3 was measured at +5 and –15°C for Na concentrations ranging from 0.005 to 0.7 mole/liter. The results, together with that at 25°C, are discussed. The composition of the Na–NH_3 solutions in terms of Na^+ and Na species is discussed. Approximate heats of dilution were calculated. Previous measurements of apparent molar volumes and the experimental conditions under which they were made are discussed. (D.L.C.)

31430 (UCRL-7448) THE VAPOUR PRESSURE OF Th(g) ABOVE ThC_2 AS DETERMINED BY EMISSION SPECTROSCOPY. Norman L. Lofgren and Oscar H. Krikorian (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 20, 1963. Contract W-7405-eng-48. 27p. (CONF-206-7)

From the Symposium on Carbides in Nuclear Energy, Harwell, Eng., Nov. 1963.

The emission intensity of atomic Th above carbon saturated ThC_2 was used as a measure of Th vapor pressure by applying the second and third laws of thermodynamics. A King (graphite tube) furnace operated at 2100 to 2500°C was used for the emission source. The inner bore of a graphite heater tube was coated with prereacted ThC_2 to provide a region of equilibrated vapor. Spectra were detected by focusing the vapor emission onto the slit of a scanning grating spectrometer. Intensities were measured with a photomultiplier. Intensity measurements were made at several temperatures for Th emission to the ground state at wavelengths of 4493.33 and 5760.55 Å, and for the C_2 (0–1) band head in the Swan system at 5635.5 Å. The second law of thermodynamics was applied to the data by using the relation $p \propto IT$. Enthalpies of reaction obtained were: ThC_2 (s) = 2C (graph) + Th(g); $\Delta H^\circ_{298} = 165$ kcal, ThC_2 (s) = C_2 (g) + Th(g); $\Delta H^\circ_{298} = 361$ kcal, 2C (graph) =

C_2 (g); ΔH°_{298} = 199 kcal. By using 137.7 kcal/g atom for the ΔH°_{298} of sublimation of Th, the data result in −26.9 ± 5 kcal/mole for the $\Delta H^\circ_{f,298}$ of ThC_2. The value for the ΔH°_{298} of sublimation of C_2 is in agreement with previous work and lends confidence to the second law treatment. In order to use the third law method a Th pressure calibration was necessary. Accordingly a W-foil tube lined on the inside with Th metal was supported within a graphite heater tube. The emission intensity was observed at 1950°C and compared with the known vapor pressure of Th to obtain the calibration factor. Corrections were applied for solubility of W in the Th, and for a difference in emitting pathlength of gas in the two types of experiments. A value of < −24.9 kcal was obtained for $\Delta H^\circ_{f,298}$ of ThC_2. Absolute errors in the determinations are difficult to evaluate. An uncertainty in the stoichiometry of the ThC_2 phase and lack of sufficient heat capacity information complicate the situation. Precision of intensity measurements is good, however, with standard deviations ranging from 0.1 to 6%. The technique can potentially provide rapid and accurate determination of thermodynamic data. It is well suited for actinide work in that it isolates radioactive materials from the detection system. (auth)

31431 (UCRL-11317(p.1-14)) INORGANIC CHEMISTRY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Nuclear magnetic resonance techniques on oxygen-17 have proven invaluable in the measurement of the very high rates of water exchange from paramagnetic transition-metal cations. The water exchange rates in complexes containing ferric, nickelous, cupric, beryllium, aluminum, and chromium(III) ions are studied. The reaction of cesium chloride solutions with chloro-complexes of ruthenium(III) ions is analyzed. The reaction of borohydride with ferricyanide is evaluated. A kinetic study of the reaction of gaseous ammonia and sulfur compounds is made along with S_4N_4 reactions with dry hydrogen chloride. (N.W.R.)

31432 (UCRL-11317(p.15-17)) CHEMICAL THERMODYNAMICS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The electronic spectra of diatomic gases and molecules are discussed. (N.W.R.)

31433 (UCRL-11317(p.18-31)) SOLID-STATE CHEMISTRY AND PHYSICS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The heat capacity of superconducting materials is evaluated along with other thermal and magnetic properties pertaining to superconductivity. Materials receiving special attention include ruthenium, hydrogen, manganese, copper-manganese alloys, and insulators. (N.W.R.)

31434 (UCRL-11317(p.32-51)) ELECTROCHEMISTRY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Activities relating to electrochemistry are summarized. Information is included on oxidation and reduction of indium at mercury electrodes, formation of neodymium chloride complexes, and electrochemistry theory and data of reported work. (N.W.R.)

31435 (UCRL-11317(p.52-78)) PHYSICAL CHEMISTRY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Research activities in physical chemistry are summarized. Information is included on molecular structure, paramagnetic resonance spectra, recombination of atoms and molecules, mass transfer, and ionization. (N.W.R.)

31436 (UJV-990/64) THERMAL DECOMPOSITION OF HYDRATED UO_3. H. Landsperský, L. Sedlávoká, and D. Jakes (Československá Akademie Věd. Ústav Jaderného Výzkumu, Rež). [1964]. 14p.

Changes of surface areas and structural changes, connected with the hydration and dehydration of UO_3 prepared from ADU by calcination, were studied. In all cases after hydration smaller surface areas were obtained. Although after dehydration amorphous UO_3 was formed, its surface area was influenced by the surface area of hydrated oxide, so that in all cases several times smaller surface areas of resulting UO_3 were formed as compared to the starting material. The grain growth of UO_3 hydrates during hydration was proved by electron microphotographs. After dehydration, the shape of those particles remained unchanged. The rate of hydration in water at 100° was so high that complete hydration was reached between several minutes and half an hour, depending on the calcination temperature of the starting UO_3. At 20° the hydration was complete in two days or perhaps sooner. In all cases the hydration in water resulted in formation of $UO_3 \cdot 2H_2O$, even at 100°. Addition of uranium peroxide to ADU (25% by weight) influenced the surface area and structure of the resulting oxides. The same fact was observed when ADU was calcined in the atmosphere of decomposed uranium peroxide. Pure amorphous UO_3 was obtained, and its surface area was close to that of UO_3 prepared only from uranium peroxide. (auth)

31437 (Y-1470-A) X-RAY FLUORESCENCE TABLES: PROGRAM DESCRIPTION. W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 21, 1964. Contract W-7405-eng-26. 47p.

A critical compilation of standard reference tables of x-ray fluorescence lines has been published in convenient form for experimental use (Reports Y-1470-B through H). This report describes the computer programs which were used to generate the tables, and provides the information necessary to generate tables for any other particular analyzing crystal. (auth)

31438 (Y-1470-H) X-RAY FLUORESCENCE TABLES: POTASSIUM ACID PHTHALATE (KAP) CRYSTAL. W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 24, 1964. Contract W-7405-eng-26. 196p.

A critical compilation of standard reference tables of x-ray fluorescence lines has been published in convenient form for experimental use for a potassium acid phthalate (KAP) crystal. (auth)

31439 (IS-Trans-3) THE HEATS OF REACTION OF LANTHANUM PERCHLORATE SOLUTIONS WITH PERCHLORIC ACID AND WITH HYDROGEN HALIDES. V. A. Latysheva and N. I. Kozachenko. Translated for Ames, Lab., Ames, Iowa, from Vestn. Leningr. Univ., Ser. Fiz. i Khim., No. 22, 135-9(1963). 7p.

Attempts were made to measure total heats of formation in lanthanum halide complex solutions by comparing the heat effects in perchloric and halogen acid solutions. The results show the enthalpies of reactions of La ions with halide ions to be endothermic and on the order of 1.0 to 0.1 kcal/mole, increasing with acid molality and decreasing in the order Cl > Br > I. Chloride complexes are definitely formed, and bromide complexes are possible, while the formation of iodide complexes are still open to question. (D.L.C.)

31440 (LA-tr-64-7) CONCERNING COMPOUNDS OF TETRAVALENT PRASEODYMIUM. 1ST COMMUNICATION. COMPLEX CHLORIDES, NITRATES, AND SUL-

FATES OF TETRAVALENT PRASEODYMIUM. S. W. Pajakoff. Translated by Gretchen R. Riese, R. A. Penneman, and L. B. Asprey (Los Alamos Scientific Lab., N. Mex.), from Monatsh. Chem., 94: 482-96(May 1963). 22p.

Dissolution of praseodymium dioxide and praseodymium (IV) hydroxide in concentrated hydrochloric, nitric, and sulfuric acids in an oxidizing atmosphere at low temperature yielded praseodymium(IV)-chloro, or praseodymium (IV)-nitrato-, or praseodymium(IV)-sulfato complexes. Praseodymium(IV)-chloro- salts were isolated by treating with solid alkali halides. Rb_2PrCl_6 and Cs_2PrCl_6 are particularly stable. The cesium salt is well-suited for the separation of praseodymium from the trivalent rare earth elements and for its purification. Solid sulfates with the composition $Pr(SO_4)_2$, $Pr(SO_4)_2 \cdot 2H_2SO_4$, and $(NH_4)_8Pr(SO_4)_6 \cdot 5H_2O$ were isolated. (auth)

31441 THERMODYNAMIC PROPERTIES OF RARE EARTH COMPLEXES. III. FREE ENERGY, ENTHALPY, AND ENTROPY CHANGES FOR THE FORMATION OF RARE EARTH ACETATE, GLYCOLATE AND THIOGLYCOLATE COMPLEXES AT 25.00°C. Ingmar Grenthe (Universiteit, Lund, Sweden). Acta Chem. Scand., 18: 283-92(1964).

The changes in free energy, enthalpy, and entropy for the formation of certain rare earth acetate, glycolate, and thioglycolate complexes were determined. All data refer to a sodium perchlorate medium of an ionic strength of 2.00M and a temperature of 25.00°C. The changes in the various thermodynamic functions were obtained from previously determined stability constants and by a direct calorimetric determination of the heats of complex formation. A comparison of the magnitude of the enthalpy changes for the various systems gave additional support to the view that the thioglycolate ion acts as an unidentate ligand while the glycolate ion forms chelates. (auth)

31442 THERMODYNAMIC PROPERTIES OF RARE EARTH COMPLEXES. IV. DISCUSSION OF FACTORS OF IMPORTANCE FOR COMPLEX FORMATION IN AQUEOUS SOLUTION. Ingmar Grenthe (Universiteit, Lund, Sweden). Acta Chem. Scand., 18: 293-9(1964).

The experimental values of $\Delta\mathfrak{K}_1^0$ and ΔS_1^0 for the formation of rare earth carboxylate complexes in aqueous solution are discussed. The similarity between the variation of $\Delta\mathfrak{K}_1^0$ and of ΔS_1^0 through the lanthanide series for the investigated complexes was considered probably connected with the hydration of the central ion. A simple model, where the cloud of water molecules surrounding the metal ion is more or less broken, as the complexes are formed, describes qualitatively both the change in enthalpy and entropy when going from one lanthanide to another and the change in enthalpy and entropy for consecutive complex formation reactions. (auth)

31443 EQUILIBRIUM OF THE REACTION BETWEEN BERYLLIUM OXIDE AND CARBON TO GIVE BERYLLIUM CARBIDE. Ketil Motzfeldt (Technical Univ. of Norway, Trondheim). Acta Chem. Scand., 18: 495-503 (1964).

The reduction of beryllia with carbon was studied by measuring carbon monoxide pressures in equilibrium with the solid phases beryllium oxide, graphite, and beryllium carbide, in the temperature range 1780 to 2320°K. The measured pressures were higher than those calculated from presently accepted thermodynamic data by a factor of 1.7, corresponding to a discrepancy of 4.0 kcal in the standard free energy of the reaction around 2000°K. (auth)

31444 CONTRIBUTIONS TO THE REDUCTION OF MOLYBDENUM TRIOXIDE. [PART] I. A. Sardi. Acta Chim. Acad. Sci. Hung., 38: 177-86(1963).

A gas flow apparatus was developed for the study of the preparation of molybdenum and intermediate molybdenum oxides and their equilibria in hydrogen-water vapor atmospheres. The study was undertaken in view of the fact that contradictions in the literature on the hydrogen reduction of molybdenum trioxide, MoO_3, could not be resolved by the thermogravimetric method. The apparatus was designed to maintain samples for long periods of time at a constant temperature and p_{H_2O}/p_{H_2} ratio in order to study the equilibria of molybdenum oxide and other metal oxides under well-defined conditions. The p_{H_2O}/p_{H_2} ratio can be maintained at any desired constant value between 0.02 and 10,000 by delivering a controlled amount of electrolytic hydrogen, carried in a stream of nitrogen (for p_{H_2O}/p_{H_2} ratios above unity), or hydrogen from a cylinder (for ratios below unity). In both cases, the gas was allowed to bubble through water in the saturator. The procedures for adjustment, measurement, and calculation of p_{H_2O}/p_{H_2} ratios are described. The amount of hydrogen admitted to the reaction furnace was controlled in the first case by adjusting the current through the electrolytic cell and in the second, by adjusting the saturator temperature. Calibration of the flowmeter, saturator, and ammeter in the case of ratios above unity or of the flowmeter and saturator in case of ratios below unity permitted calculation of the p_{H_2O}/p_{H_2} ratio. Operation of the apparatus and methods for analysis of the reaction products are described. (OTS)

31445 THEORY OF GAS-SOLID CHROMATOGRAPHY. POTENTIAL FOR ANALYTICAL USE AND THE STUDY OF SURFACE KINETICS. J. Calvin Giddings (Univ. of Utah, Salt Lake City). Anal. Chem., 36: 1170-5(June 1964).

The theory of gas-solid chromatography in packed and capillary columns was developed and is discussed. Particular emphasis was placed on expressing the important plate height coefficient, C_k, in terms of known parameters. The accommodation coefficient, α, a parameter that has often been measured in connection with surface studies, is used to express the rate of adsorptive-desorptive mass transfer. The theory shows that C_k is very small, the order of 10^{-7} second, for typical packed columns with uniform adsorptive sites. Nonuniform surfaces exhibit a C_k, which is larger by a heterogeneity factor, σ. The equation for σ provides the first quantitative basis for the effects of nonuniformity, and indicates the energy difference between sites required for column deterioration. An examination of the analytical potential of gas-solid chromatography indicates real advantages in terms of column efficiency and high speed analysis. A great potential is shown to exist for enhancing selectivity by making use of the steric nature of the adsorption forces. Finally, gas-solid chromatography is shown to have a real potential for the measurement of surface kinetics. (auth)

31446 SEPARATION OF LEAD BY ANION EXCHANGE. Johann Korkisch and Franz Feik (Universität, Vienna). Anal. Chem., 36: 1793-6(Aug. 1964).

A method for the anion exchange separation of lead from various elements employs the strongly basic anion exchange resin Dowex 1, X8. As a medium for this separation, a mixture consisting of 90% tetrahydrofuran and 10% 5N nitric acid was selected. From this solution lead is adsorbed much more strongly on the resin than most other elements, so that an ion exchange separation by column chromatography by using the mixture as the eluent is easily possible. Uranium, thorium, bismuth, thallium, the lanthanides from

samarium to lutetium, iron, magnesium, calcium, and other elements pass quantitatively into the eluate, whereas the rare earth elements lanthanum to neodymium are retained on the resin with lead. Lead is subsequently eluted with a mixture of 80% tetrahydrofuran and 20% 2.5N nitric acid. The distribution coefficients were measured for numerous elements as a function of varying concentrations of nitric acid and tetrahydrofuran. (auth)

31447 THERMOGRAVIMETRIC INVESTIGATION OF SCANDIUM, YTTRIUM AND THE RARE EARTH METAL DILITURATES. Milton W. Goheen and Rex J. Robinson (Univ. of Washington, Seattle). Anal. Chim. Acta, 31: 71-80(July 1964).

Thermolysis curves for scandium, yttrium, lanthanum, cerium(III), neodymium, samarium, gadolinium, dysprosium, and erbium diliturates are described. Scandium diliturate forms a 15-hydrate which dehydrates in 3 steps. The other diliturates all form 12-hydrates which dehydrate smoothly. All of the anhydrous diliturates are thermally stable to about 240°. Solubilities in water for scandium, yttrium, lanthanum, cerium(III), neodymium, samarium, gadolinium, dysprosium, and erbium diliturates are given. Scandium diliturate was the most soluble and neodymium diliturate the least soluble. Solubilities of rare earth diliturates not investigated could be predicted approximately. Methods for thermogravimetric determination of yttrium, lanthanum, neodymium, samarium, gadolinium, dysprosium, and erbium as the diliturates were developed. The precipitates were quite dense, easily handled and filterable. Weighing as the diliturate salts gave these determinations a very favorable gravimetric factor. (auth)

31448 QUENCH FREQUENCY EFFECTS ON THE NUCLEAR QUADRUPOLE RESONANCES OF SOME HALOGEN COMPOUNDS. M. J. Bogaard (Univ. of Sydney), S. Hacobian, W. Hay, and E. P. A. Sullivan. Australian J. Chem., 17: 611-21(June 1964).

The effect of quench frequency on ^{35}Cl and ^{127}I nuclear quadrupole resonances of some halogen compounds was investigated at various temperatures using pulsed type oscillators. The observed signal-to-noise ratio of the nuclear signal versus quench frequency curve for each compound studied showed a number of maxima that can be explained in terms of nuclear induction phenomena. (auth)

31449 ^{199}Hg WIDE LINE N.M.R. SPECTRA OF CHLORIDE COMPLEXES OF MERCURY. P. D. Godfrey (Monash Univ., Clayton, Australia), M. L. Heffernan, and D. F. Kerr. Australian J. Chem., 17: 701-4(June 1964).

NMR measurements were carried out for stoichiometric concentrations of Hg(II) of 0.5 and 1 M, in aqueous solutions containing various amounts of added solid LiCl. In all measurements of the resonance position of ^{199}Hg at various Cl-concentrations, only single resonance was found, although significant concentrations of all three species were present. The presumed interpretation of the single resonance, when three Hg(II) species are present, is that there must be a rapid exchange of Cl^- ligands from one complex ion to another. This is borne out by the systematic variation of the experimental resonance field with (Cl^-). From the results, the expected σ value can be estimated for stoichiometric $HgCl_4^{2-}$ in solution, namely when the ratio of $(HgCl_2)$ to added (Cl^-) is 1:2, at concentrations of 0.5 and 1.0 M, as 2.4×10^{-4} and 2.6×10^{-4}, respectively. (P.C.H.)

31450 MOLECULAR SPECTROSCOPY OF ANHYDROUS URANYL SALTS. IV. INFRARED SPECTRA OF ANHYDROUS URANYL NITRATE AND ITS HYDRATES. B. Kedzia and B. Jezowska-Trzebiatowska (Technical Univ., Wroclaw, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 12: 243-50(1964).

The infrared spectrum of anhydrous uranyl nitrate does not exhibit bands characteristic of coordinated water. Its other features are similar to those of the spectra of di- and trihydrate of uranyl nitrate. The band characteristic for uranyl symmetric stretching in spectra of di- and trihydrate was not observed. However, the 868 cm^{-1} band was identified as belonging to the symmetric stretching of uranyl ion. Frequencies characteristic of bending and stretching modes of water molecules were observed in the spectra of lower hydrates. These bands allow the di- and trihydrate of uranyl nitrate to be discerned. Data are tabulated. (P.C.H.)

31451 MOLECULAR SPECTROSCOPY OF ANHYDROUS URANYL SALTS. V. PROPERTIES AND STRUCTURE OF ANHYDROUS URANYL NITRATE AND ITS HYDRATES. B. Jezowska-Trzebiatowska and B. Kedzia (Technical Univ., Wroclaw, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 12: 251-4(1964).

The results of studies on the infrared spectra of anhydrous uranyl nitrate and its hydrates concerning properties and structure are discussed. The spectral analysis established a decrease of uranyl fundamentals with a step-wide dehydration of uranyl nitrate. In the anhydrous compound and in spectra of its lower hydrates, the changes occur regularly, while the hexahydrate exhibits certain deviations from the observed regularities. The changes of uranyl fundamentals are an evidence of the loosening of bonds in the uranyl group during dehydration. Suggested structures are illustrated. (P.C.H.)

31452 THE SYNTHESIS OF DEUTERATED POLYPROPYLENES. Shunsuke Murahashi, Shun'ichi Nozakura, and Katsutoshi Yasufuku (Osaka Univ. and Inst. of Physical and Chemical Research, Tokyo). Bull. Chem. Soc. Japan, 37: 855-9(June 1964).

The synthesis of propylene-d_6 and propylene-1,1,2-d_3 was attempted for an infrared spectroscopic study of the isotactic polymers. Propylene-d_6 was synthesized by the half-deuteration of the propyne-d_4, which was obtained by the hydrolysis of magnesium carbide with deuterium oxide, and propylene-1,1,2-d_3 was synthesized by the reaction of deuterovinyl magnesium bromide and dimethyl sulfate. In the half-reduction of propyne-d_1 with a Lindlar catalyst, it was found that an equilibrium between propyne-1-d_1 and allene-1-d_1 exists on the catalyst. The polymerization of these monomers was carried out with a Ziegler-Natta catalyst, and isotactic polymers were obtained. In the copolymerization of propylene and propylene-1,1,2-d_3 with a Ziegler-Natta catalyst, it was observed that some of the infrared crystalline sensitive bands of isotactic polypropylene, 1164, 998, and 838 cm^{-1}, do not exist (or at least diminish) in the copolymer but do exist in artificial mixtures of the homopolymers. This evidently suggests that the infrared bands are due to an intrachain interaction in the crystalline part of the polymer. (P.C.H.)

31453 THE SOLUBILITY AND ANION EXCHANGE BEHAVIOR OF HEAVY LANTHANIDE ELEMENTS IN A POTASSIUM CARBONATE SOLUTION. Tomitsugu Taketatsu (Kyushu Univ., Fukuoka). Bull. Chem. Soc. Japan, 37: 906-7(June 1964).

The behavior of tripositive lanthanide elements other than Ce, Pr, Pm, and La in potassium carbonate solution was investigated. The results showed that there was a distinct difference between the heavy lanthanide elements (Er, Tm, Yb, Lu, and Y) and the other light elements. The anion exchange resin used was 1 g of Dowex

1, X-8, in the carbonate form, of the 50 ~ 100 mesh size. When the amount dissolved was more than about 3×10^{-5} mole/ml, the solubility increased with the increase in atomic number. The distribution coefficient (K_d, cc/g) increased with the increase in atomic number from Nd to Dy or Ho; on the other hand, the values decrease with the increase from Er to Lu. The position of Y was found to be between Er and Ho. The maximum K_d value corresponds with the maximum magnetic susceptibility of the lanthanide element. (P.C.H.)

31454 KINETIC STUDY OF THE OXIDATION OF URANIUM MONONITRIDE BY PURE OXYGEN. Jean Besson, Claude Moreau, and Joseph Philippot (CEN, Grenoble, France). Bull. Soc. Chim. France, No. 5, 1069-74(May 1964). (In French)

The reaction of oxygen on fritted uranium mononitride was studied at 350 to 480°C and at pressures from several mm of Hg to atmospheric pressure. This reaction leads to an oxide with intermediate formula between U_3O_8 and UO_3. It obeys linear kinetics, resulting probably from a true interface regime. However, the effect of the pressure on the reaction does not allow this mechanism to be confirmed. (tr-auth)

31455 A GROUP ORBITAL STUDY OF LITHIUM HYDRIDE. I. G. Csizmadia, B. T. Sutcliffe, and M. P. Barnett (Massachusetts Inst. of Tech., Cambridge). Can. J. Chem., 42: 1645-63(July 1964).

A quantum mechanical treatment of lithium hydride in the group orbital approximation is presented. Some excited states and an improved ground state were obtained by means of configuration interaction within a single group. The total energy obtained for the ground state at several interatomic distances (R = 2.0 – 8.0 au) omitting and including configuration interaction and for the first excited singlet state compare very well with values previously reported in a comparable simple molecular orbital calculation. The chemical significance of the group orbital method is discussed. The results of the present calculations are related to some chemical reaction mechanisms and to some spectroscopic phenomena. (auth)

31456 THE URANIUM–HYDROGEN–HYDRIDE SYSTEM OF URANIUM. Jean Besson and Jacques Chevallier (CEN, Grenoble, France). Compt. Rend., 258: 5888-91 (June 15, 1964). (In French)

The formation and composition of the sub-stoichiometric hydride UH_{3-x} were studied from 211 to 407°C. Between these temperatures the boundary value of the ratio H/U varied from 2.994 to 2.981. The dissociation pressure of the hydride p_0 is represented by the relation $\log p_0$ (mm of Hg) = 9.21–4460/T°K. The heat of formation is practically constant at 30.5 kcal. (tr-auth)

31457 EVALUATION OF CURRENT DISTRIBUTION IN ELECTRODE SYSTEMS BY HIGH-SPEED DIGITAL COMPUTERS. J. A. Klingert, S. Lynn, and C. W. Tobias (Univ. of California, Berkeley). Electrochim. Acta, 9: 297-311 (1964). (UCRL-10998)

In the absence of significant concentration gradients, the distribution of potential in electrolytic cells can be satisfactorily described by the Laplace equation. Because of mathematical difficulties, in the past analytical solutions were obtained only for a few, simple cell configurations. In other fields of application it was known that the finite-difference form of the Laplace equation by iterative procedure is suited for numerical solution by digital computers. The method was found to be suitable for handling any arbitrary two-dimensional cell geometry, and allows consideration of realistic overpotential behavior. The elementary mathematical relations involved and the iterative procedure employed in machine computations are described. By the use of this technique, the primary and secondary current-density distributions were evaluated for the outside corner of an electrode, a model representative of cell geometries commonly employed in industry. The effects of the variations of geometric and overpotential parameters are demonstrated. The results obtained indicated that the numerical technique employed is eminently suitable for rapid and accurate evaluation of current-density distributions for realistic models. (auth)

31458 ON THE NATURE OF ELECTRON ABSORPTION SPECTRA IN URANYL COMPOUNDS. L. V. Volod'ko, A. N. Sevchenko, and D. S. Umreiko (Belorussian State Univ., USSR). Fiz. Probl. Spektroskopii. Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 233-6(1962). (In Russian)

The polarization, dichroism, and symmetry properties of the absorption spectra of monocrystalline uranyl nitrate were investigated. The results were compared with theoretical calculations. (C.E.S.)

31459 ION SPECTRA OF RARE EARTHS—THE PROBES OF CRYSTALLINE FIELD. I. LATTICE OF A PEROVSKITE TYPE. A. F. Yatsenko and L. M. Rabkin (Rostov State Univ., USSR). Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 239-42(1962). (In Russian)

The emission spectra of Pr and Sm ions in polycrystalline $BaTiO_3$, $SrTiO_3$, and $CaTiO_3$ were investigated. The rare earth concentrations ranged from 0.1 to 1.0 mole%. The spectra were used to obtain information on the crystalline fields in seignettoelectric materials with a Perovskite structure. (C.E.S.)

31460 CORRELATIONS OF ABSORPTION SPECTRA OF AMERICIUM AND EUROPIUM IN CRYSTALS AND IN SOLUTIONS. D. S. Gorbenko-Germanov (Kurchatov Inst. of Nuclear Energy, Academy of Sciences, USSR). Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 242-7(1962). (In Russian)

The absorption spectra of Am^{3+} and Eu^{3+} were investigated at 3000–11000 Å in $HClO_4$ and H_2SO_4 and at 4500–8500 Å in sulfate crystals to determine the properties of the electron transitions. The energies of the ^7F sublevel multiplets, the shielding constant, and the effective nuclear charge were determined. (C.E.S.)

31461 INFRARED SPECTRA AND STRUCTURE OF URANYL COMPOUNDS. A. V. Babaeva, V. P. Markov, O. N. Evstaf'eva, and I. V. Tsapkina (Kurnakov Inst. of General and Inorganic Chemistry, USSR). Fiz. Probl. Spektroskopii, Akad. Nauk SSR, Materialy 13-go [Trinadtsatogo] Soveshch, Leningrad, 1960, 1: 417-20(1962). (In Russian)

The infrared spectra of uranyl complexes of the form $UO_2 \cdot X \cdot nCO(NH_2)_2$, where X is SO_4, C_2O_4, or $(NO_3)_2$, were investigated to obtain information on the oscillation frequency of the uranyl, nitrate, and sulfate ions. (C.E.S.)

31462 INFRARED SPECTRA OF COMPLEX URANYL NITRATE COMPOUNDS. V. M. Vdovenko, D. N. Suglobov, and V. A. Krasil'nikov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 420-2(1962). (In Russian)

The symmetric and antisymmetric oscillation frequency of the uranyl group and the reference frequency of the nitrate group were determined in the infrared spectra of

uranyl nitrate and complexes of the form $UO_2(NO_3)_2 \cdot 2S$, where S is a molecule of nitrogen dioxide, water, acetonitrile, methylethylketone, ethyl ether, or pyridine. (C.E.S.)

31463 OSCILLATION SPECTRA OF URANYL TRICARBONATES AND URANYL TRINITRATES IN CRYSTALS OF ALKALI METALS. D. S. Gorbenko-Germanov and R. A. Zenkova (Kurchatov Inst. of Nuclear Energy, Academy of Sciences, USSR). Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 422-7(1962). (In Russian)

The emission and infrared absorption spectra of crystalline compounds of the form $R_4[UO_2(CO_3)_3]$ and $R[UO_2(NO_3)_3]$, where R is K, Rb, or Cs, were investigated. The oscillation frequencies of the UO_2^{2+}, CO_3^{2-}, and NO_3^- ions were determined. The U–O bond lengths and coupling constants and the crystal structure parameters were presented for each compound. (C.E.S.)

31464 COMPLEX FORMATION BETWEEN CEROUS CHLORIDE AND ETHYLENEDIAMINE HYDROCHLORIDE. M. C. Saxena (Univ. of Saugar, India). Indian J. Chem., 2: 244-5(June 1964).

The complex formation between cerous chloride and ethylenediamine hydrochloride was studied conductometrically by monovariation as well as continuous variation methods. The chelate formed in solution can be represented by the formula CeR_3 (R = reagent). (auth)

31465 HYDROLYTIC URANYL SPECIES AND THEIR EMISSION SPECTRA. D. D. Pant and H. D. Bist (Government Coll., Nainital, India). Indian J. Pure Appl. Phys., 2: 223-8(July 1964).

Fluorescence spectra of hydrolytic species in alkaline solutions of aqueous uranyl perchlorate, nitrate, and chloride were studied. The changes in the spectra were found similar. Eight distinctly new spectra are observed with increasing pH until the nonfluorescent precipitate is obtained. The discontinuities observed in the variation of the pure electronic transition frequency ν_e with volume of alkali are similar to those observed in the variation of pH with dilution, thus indicating the formation of distinct species. The frequency ν_e shifts towards the red side and the vibration frequency decreases with the species formed with greater hydrolyzation. The intensity distribution also changes, progressively shifting towards the violet end. Solid precipitates obtained during titration with the alkali behave similarly. These observations support the formation of polynuclear hydrolytic species in which the uranyl ion forms species of the type $[UO_2(OH)_2]_nUO_2^{2+}$ or $[UO_3H_2O]_n$ UO_2^{2+} by an oxygen bridging mechanism. The modified Badger's formulas for calculating internuclear distances of the U–O bond were used to calculate the internuclear distances of the hydrolyzed species. The calculated values agree well with literature values up to the last stage of the nonfluorescent uranates. (auth)

31466 PHASE EQUILIBRIUM IN LANTHANUM ALUMINUM OXIDE SYSTEM. I. A. Bondar and N. V. Vinogradova (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 5, 785-90 (May 1964). (In Russian)

The phase equilibrium was studied in the lanthanum oxide–aluminum oxide system (from 99.90% La_2O_3 to 99.99% Al_2O_3) annealed at 2300 to 1600°C. Preparations of perovskite type $LaAlO_3$ and β-alumina type $La_2O_3 \cdot 11Al_2O_3$ are described and the existence of the metastable compound $La_2O_3 \cdot 11Al_2O_3$ was established. (R.V.J.)

31467 ELECTRON EXCHANGE KINETICS OF THE NO_3 FREE RADICAL IN SOLUTION. T. W. Martin, R. E. Rummel, and R. C. Gross (Vandervilt Univ., Nashville). J. Am. Chem. Soc., 86: 2595-2600(July 5, 1964).

The NO_3 free radical can be generated photochemically in aqueous 6M nitric acid by the primary electron-exchange reaction, $Ce^{IV}NO_3^- + h\nu \rightarrow Ce(III) + NO_3$. Possible secondary reactions between NO_3 and added solutes were found to be in competition with the fast spontaneous bimolecular electron back-exchange process, $NO_3 + Ce(III) \rightarrow Ce^{IV}NO_3^-$. By means of an improved flash kinetic method, which features a simplified photolysis lamp design and an ignitron firing technique, the rate of the second reaction was measured to be $(1.70 \pm 0.04) \times 10^6\ \underline{M}^{-1}\ sec^{-1}$ at 23°C with good precision. The back-exchange process was only slightly temperature dependent, with an apparent activation energy estimated to be approximately 1.0 ± 0.2 kcal/mole over the interval from 23 to 50°C. An interpretation of these results and their role in explaining the slow decomposition of ceric nitrate salts in nitric acid solution is discussed. (auth)

31468 THE OXIDATION OF AROMATIC ALDEHYDES BY CHROMYL ACETATE. Kenneth B. Wiberg and Paul A. Lepse (Univ. of Washington, Seattle). J. Am. Chem. Soc., 86: 2612-19(July 5, 1964).

The kinetics and stoichiometry of the oxidation of benzaldehyde by chromyl acetate was studied. The reaction proceeds in two stages, the first giving chromium(V) and the second giving chromium(IV). Both reactions are first order in benzaldehyde and in the oxidant, show a kinetic isotope effect, and involve oxygen transfer from the oxidant to the aldehyde. The possible mechanisms are discussed. (auth)

31469 CARBONYL-STRETCHING ABSORPTIONS IN THE PENTACARBONYL HYDRIDES OF MANGANESE, TECHNETIUM, AND RHENIUM. C. Corvaja and G. Giacometti (Universitá, Padua). J. Am. Chem. Soc., 86: 2734-6(July 5, 1964).

Structures for pentacarbonyl hydrides of manganese, technetium, and rhenium are discussed on the basis of infrared spectra of $HMn(CO)_5$. (M.C.G.)

31470 MELLITIC ACID FROM THE OXIDATION OF GRAPHITE WITH 90% NITRIC ACID. Leslie M. Ferris (Oak Ridge National Lab., Tenn.). J. Chem. Eng. Data, 9: 387-8(July 1964). (ORNL-TM-623)

The products formed in the oxidation, with 90% HNO_3, of a nuclear grade graphite were determined. Less than 6% of the graphite that was oxidized was converted to soluble species, indicating that the main reaction product was CO_2. The red-brown to yellow soluble species were mixtures of polyfunctional aromatic acids. The main component of the mixtures was mellitic acid. (M.C.G.)

31471 ELECTRICAL CONDUCTANCE AND DENSITY IN MOLTEN TUNGSTEN(VI) OXIDE–ALKALI (Li,Na,K) TUNGSTATE SYSTEMS. Kelso B. Morris and Press L. Robinson (Howard Univ., Washington, D. C.). J. Chem. Eng. Data, 9: 444-5(July 1964).

Precise measurements of electrical conductance and density are reported for molten tungsten(VI) oxide–alkali (Li,Na,K) tungstate systems. The method of least squares was applied to the raw data in order to obtain second order and first order equations, which represent the temperature dependence of specific conductance and density, respectively, in the three systems. Data for these systems were extended to nearly 60 mole% WO_3 because phase diagrams for these systems do not indicate higher solubility for the tungsten(VI) oxide in the tungstate melts. (auth)

31472 CALCULATION OF INTENSITY DISTRIBUTION IN THE VIBRATIONAL STRUCTURE OF ELECTRONIC

TRANSITIONS: THE B $^3\Pi_{0^+u}$–X $^1\Sigma_{g}{}^+$ RESONANCE SERIES OF MOLECULAR IODINE. R. N. Zare (Univ. of California, Berkeley). J. Chem. Phys., 40: 1934-44(Apr. 1, 1964). (UCRL-11110)

Franck-Condon overlap integrals were calculated that predict within experimental error the intensity distribution of the sixty measured lines in the visible fluorescence spectrum of molecular iodine, B $^3\Pi_{0^+u}(v' = 15, 16, \text{or } 26) \rightarrow$ X $^1\Sigma_{g}{}^+(v'' = 0 \text{ to } 69)$. Rydberg-Klein-Rees potentials were used for both electronic states, and exact vibrational eigenfunctions were obtained by direct numerical solution of the radial Schrödinger equation, including vibration-rotation interaction. The electronic transition moment was assumed to be independent of internuclear distance. Overlap integrals derived in the same way for Morse potentials fail to give even qualitative agreement with experiment for lines with $v'' \gtrsim 10$. Because of the rapid oscillation of the vibrational wavefunctions for high v' and v'', a shift in the potential of only 0.002 Å is found to alter appreciably the calculated intensity distribution; thus the agreement obtained provides a very severe test of the RKR potentials and the Franck-Condon principle. The radiative lifetime of the B state was also calculated from the absolute intensity of a single line and the integrated intensity of the band system, and the results compare favorably with direct lifetime measurements. (auth)

31473 ASSIGNMENT OF HYPERFINE SPLITTINGS IN ELECTRON SPIN RESONANCE SPECTRA BY LINEWIDTH ANALYSES. James R. Bolton and George K. Fraenkel (Columbia Univ., New York). J. Chem. Phys., 41: 944-8 (Aug. 15, 1964).

A method was developed for the assignment to nuclear positions of the hyperfine splittings in the electron spin resonance spectra of free radicals in solution. The procedure is applicable to the splittings from the nuclei of atoms with a nonvanishing pi-electron spin density, and it is thus useful for ^{13}C and ^{14}N splittings, but cannot be employed for proton splittings. The technique used depends on linewidth effects. It is shown that one contribution to the linewidths is approximately proportional to the square of the spin density on the atom containing the nucleus of interest (the local spin density), and that, under appropriate conditions, splittings from nuclei at positions with high spin density show greater linewidth effects than those from positions with low spin density. The technique was applied to two of the ^{13}C splittings from nuclei present in natural abundance in the spectrum of the anthracene negative ion radical. (auth)

31474 LINE SHAPES IN ELECTRON SPIN RESONANCE SPECTRA. Julien Gendell, Jack H. Freed, and George K. Fraenkel (Columbia Univ., New York). J. Chem. Phys., 41: 949-59(Aug. 15, 1964).

The theory of the linewidths in the electron spin resonance spectra of free radicals recently developed by Freed and Fraenkel predicts that, in general, composite lines arising from a set of degenerate nuclear spin-states should not be Lorentzian in shape, and that the shapes of different lines in the same spectrum should be different. The earlier theory of Kivelson predicted that all the lines should be Lorentzian. To test the differences between the two theories, experimental studies of the line shape in the spectrum of the tetracyanoethylene anion were made in a solvent consisting of a mixture of absolute ethanol and glycerine. Different lines were found to have different shapes, and the shapes were well represented by a sum of Lorentzian-shaped components, in agreement with the newer theory. Studies of dimethylsulfoxide solutions of the p-benzosemiquinone ion were also made. The spectra obtained in this system show only small linewidth variations and, in agreement with the theory, the variations in line shape are negligible. It was also possible to demonstrate that the nitrogen hyperfine splitting a^N in the tetracyanoethylene radical is positive. (auth)

31475 CENTRIFUGAL DISTORTION EFFECTS AND STRUCTURE OF HYDRAZOIC ACID FROM THE MILLIMETER WAVE ROTATIONAL SPECTRA. Manfred Winnewisser and R. L. Cook (Duke Univ., Durham, N. C.). J. Chem. Phys., 41: 999-1004(Aug. 15, 1964).

The rotational spectra of two ^{15}N-substituted species of hydrazoic acid were investigated, and the values of the rotational constants are given. With the aid of the rotational constants for $H^{14}N_3$ and $D^{14}N_3$ the structural parameters were obtained. An important part of the study was the investigation of the centrifugal stretching behavior exhibited by HN_3 and its isotopic species. It was found that even at low J the introduction of P^6 distortion terms for higher K_{-1} transitions is essential to accurately account for the observed rotational frequencies. (P.C.H.)

31476 DIFFUSION OF HELIUM IN SILICON, GERMANIUM, AND DIAMOND. Lars C. Luther and Walter J. Moore (Indiana Univ., Bloomington). J. Chem. Phys., 41: 1018-26(Aug. 15, 1964).

The diffusion coefficients D of helium in silicon, germanium, and diamond were determined from the rate of evolution of helium upon heating boron-doped crystals after slow neutron irradiation. The 90% confidence level for the activation energies is indicated. Experiments in which helium was introduced into silicon by ion bombardment from a discharge plasma gave values of D concordant with the other value. The activation energies were calculated theoretically from the differences in interaction energies of the helium in the interstitial site and at the saddle point between two such sites. An exp-6 potential was used with parameters estimated from inert-gas interactions. The theoretical E values were C: 24.8, Si: 6.7, and Ge: 6.4 kcal. The pre-exponential factors D_0 as calculated from the vibration frequencies of the interstitial helium were about 10 times higher than the observed. (P.C.H.)

31477 REACTION OF DEUTERATED POLYSTYRENES WITH HYDROGEN AND DEUTERIUM ATOMS. Leo A. Wall (National Bureau of Standards, Washington, D. C.) and Ronald B. Ingalls. J. Chem. Phys., 41: 1112-20(Aug. 15, 1964).

Investigation of the electron spin resonance spectra shown by finely divided polystyrene and selectively deuterated polystyrenes, upon exposure either to hydrogen atoms or to deuterium atoms, demonstrates that the predominant reaction is the addition of a hydrogen atom to the phenyl ring, thus producing a cyclohexadienyl-type radical. The specific rate of this reaction at room temperature is estimated to be 4×10^3 liters $\text{mole}^{-1} \cdot \text{sec}^{-1}$; the specific rate at which hydrogen atoms react with the cyclohexadienyl-type radical is estimated to be 10^6 liters $\text{mole}^{-1} \cdot \text{sec}^{-1}$. The rate at which iodine vapor reacts with the cyclohexadienyl radicals is probably about the same value. Qualitatively, the results produce an insight into the mechanism of the radiolysis of polystyrene. It seems evident that although the mechanism is complex, both the evolved hydrogen and the crosslinking seen in the irradiation of polystyrene occur by means of radical precursors. (auth)

31478 MECHANISM OF PROTON TRANSFER IN ACID-BASE REACTIONS. Joseph J. Weiss (Univ. of Newcastle upon Tyne, Eng.). J. Chem. Phys., 41: 1120-4 (Aug. 15, 1964).

It is proposed that proton transfer in acid–base reactions goes by a quantum-mechanical tunnel effect. The predominance of the tunnel effect in these reactions is attributed to the recognition that the proton transfer can proceed along a hydrogen bond between the two reactants and the distance that the proton has to travel is only 0.4 to 0.6 Å. On this basis some calculations were carried out with a one-dimensional Eckart potential barrier, the (apparent) activation energy of the proton transfer being identified with the endothermicity (Q) of the proton-transfer reaction: $AH + B \rightarrow A + HB - Q$. For the primary isotope effect for proton and deuteron transfer, it can be shown that increase of the (apparent) activation energy for the deuteron transfer (due to the difference in the zero-point energies) necessarily also affects the magnitude of the transmission coefficient and that this effect can compensate, to a greater or lesser extent, for the increased mass of the deuteron. The Brønsted relation in acid–base catalysis can also be derived, as a first approximation, from such a model and without any further a priori assumptions between activation energies and free energies. (auth)

31479 STUDY OF THE REACTION OF Cs WITH Br_2 IN CROSSED MOLECULAR BEAMS. Sheldon Datz and Robert E. Minturn (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 41: 1153-4(Aug. 15, 1964). (ORNL-P-34)

Crossed molecular-beam techniques were used to study the reaction of Cs with Br_2. A monoenergetic beam of Cs atoms (obtained by passing a thermal beam through a six-disk mechanical velocity selector) collided at right angles with a molecular beam of Br_2. The scattering was observed with a differential surface-ionization gage containing a W wire and a Pt alloy (92% Pt – 8% W) wire, the latter being relatively insensitive to CsBr. The elastic scattering pattern of Cs from Br_2 displayed no rainbow scattering phenomena. Instead the Cs distribution was sharply attenuated even at relatively low scattering angles. This is interpreted to mean a large chemical reaction cross section. The relative scattering patterns for several Cs velocities are illustrated. (P.C.H.)

31480 REACTIVE SCATTERING IN MOLECULAR BEAMS: EVIDENCE FOR A STRIPPING MECHANISM IN REACTIONS OF ALKALI ATOMS WITH HALOGENS. K. R. Wilson (Univ. of California, Berkeley), G. H. Kwei, J. A. Norris, R. R. Herm, J. H. Birely, and D. R. Herschbach. J. Chem. Phys., 41: 1154-6(Aug. 15, 1964).

Crossed beam studies were made of the reactions of K, Rb, Cs atoms with Br_2, I_2, and ICl, and IBr. It was found that, for all these systems: the reaction cross sections are remarkably large, $\gtrsim 100$ Å^2; much of the alkali halide product recoils forward with respect to the incident alkali-atom beam; and most of the chemical energy released appears as vibrational excitation of the alkali halide. (P.C.H.)

31481 NONEXPONENTIAL DECAY OF LUMINESCENCE OF RARE-EARTH CHELATES. M. L. Bhaumik, L. J. Nugent, and L. Ferder (Electro-Optical Systems, Inc., Pasadena, Calif.). J. Chem. Phys., 41: 1158-9 (Aug. 15, 1964).

An attempted explanation for the previously reported nonexponential decay for the $^5D_0 \rightarrow {}^7F_2Eu^{3+}$ luminescence of europium dibenzoylmethide and thenoyltrifluoroacetonate chelates in methylcyclohexane, ethyl alcohol, and toluene at 77°K is made by postulating the existence of a metastable state of lifetime in the range of 10^{-5} sec in the sequence of energy transfer between initial excitation of the ligand and subsequent excitation of the emitting level of the europium ion. Stroboscopic measurements clearly showed the luminescence rise to be exponential with a rise-time of 2 μsec for both chelates in ethanol solution at 77°K. (P.C.H.)

31482 POLAROGRAPHY OF HYDROGEN PEROXIDE IN LANTHANUM NITRATE SOLUTIONS. Mary T. Henne and Justin W. Collat (Ohio State Univ., Columbus, Ohio). J. Electroanal. Chem., 7: 359-67(May 1964).

The reduction of hydrogen peroxide at the D.M.E. was catalyzed in lanthanum salt solutions. In 0.01 M $La(NO_3)_3$ it was found that a cathodic hydrogen peroxide current appears at +0.2 v vs S.C.E., followed by a depression in the current that extends to the main hydrogen peroxide wave at −0.3 v. Experiments on suspensions of lanthanum hydroxide in lanthanum nitrate–hydrogen peroxide solutions showed that the reduction current at potentials more oxidizing than −0.3 v increased upon contact with the solid, while the height of the normal wave decreased. Filtration of these mixtures and tests with potassium permanganate and nitric acid on the filtrate indicated that the species responsible for the reduction current was soluble, oxidizable, and unstable to acid. Mercury in contact with the lanthanum nitrate–hydrogen peroxide test solution led to the more rapid production of this species along with the evolution of oxygen. A soluble complex between lanthanum ion and hydrogen peroxide, formed under mildly alkaline conditions, is postulated as the species being reduced. The suppression of the catalytic current in the potential range +0.1 to −0.2 v is interpreted as the result of adsorption of insoluble lanthanum hydroxide or polymeric lanthanum hydroxy-complexes on the D.M.E. Current-time curves consistent with this explanation were obtained. (auth)

31483 THE DISTRIBUTION OF CARRIER-FREE SILVER-110M BETWEEN MERCURY AND AQUEOUS SOLUTIONS OF MERCUROUS PERCHLORATE. H. L. Hamester and M. Kahn (Univ. of New Mexico, Albuquerque). J. Inorg. Nucl. Chem., 26: 1139-42(July 1964). (SC-DC-3477)

Measurements of the distribution of carrier-free silver-110m between mercury and aqueous solutions of mercurous perchlorate indicate that the equilibrium constant expression for the reaction, $2Hg + 2Ag^+(aq) = Hg_2^{2+}(aq) + 2Ag(Hg)$, is valid at silver(I) concentrations as low as $\sim 2 \times 10^{-10}$f. (auth)

31484 THERMAL DECOMPOSITION OF YTTERBIUM OXALATE. A. Glasner, E. Levy, and M. Steinberg (Hebrew Univ., Jerusalem). J. Inorg. Nucl. Chem., 26: 1143-9 (July 1964).

The paths followed in the thermal decomposition of ytterbium oxalate depend on the external conditions. Partial reduction to divalent ytterbium occurs in vacuum. These results confirm previous postulates: that in solid reactions of the type $solid_A \rightarrow solid_B + gas$, a high pressure of the evolving gases is built up in the reacting solid material, and that the reduction of the cation in the decomposition of certain oxalates is due to a catalytic action of carbon monoxide. (auth)

31485 POLAROGRAPHY OF URANYL–MALONATE CHELATES. Tsai-teh Lai and Ching-chiang Hsieh (Cheng Kung Univ., Taiwan, China). J. Inorg. Nucl. Chem., 26: 1215-20(July 1964).

The polarography of uranyl ion in malonic acid solution was studied at 30°C under widely varying conditions of ligand concentration and pH. The ligand species was proved to be a malonate anion. The half-wave potential vs pH data were interpreted on the basis of pK values for the acid ionization, and resulted in an excellent agreement with the deduction. The mole ratio of metal to ligand was found to be

1:1 and 1:2 by conductometric titration. The electrode reactions were established as $UO_2A_2^{2-} + 2H^+ + e = UO_2A^- + H_2A$ ($pH < pK_1 < pK_2$), $UO_2A_2^{2-} + H^+ + e = UO_2A^- + HA^-$ ($pK_1 < pH < pK_2$), and $UO_2A_2^{2-} + e = UO_2A_2^{3-}$ ($pH > pK_2 > pK_1$). (auth)

31486 STABILITY CONSTANTS OF SCANDIUM(III) CHLORIDE COMPLEXES. G. L. Reed, K. J. Sutton, and D. F. C. Morris (Brunel Coll., London). J. Inorg. Nucl. Chem., 26: 1227-31(July 1964).

Stepwise equilibria in aqueous solutions of scandium chloride were investigated for chloride concentrations up to 0.64M. Scandium-46 was employed in conjunction with a cation-exchange resin in the H^+-form, and the ionic strength was maintained at 0.691M with perchloric acid. The existence of the species $ScCl^{2+}$ and $ScCl_2^+$ was established and their stability constants, β_j, were determined from least squares analysis using a digital computer. (auth)

31487 ELECTRIC-POLARIZATION AND STRUCTURE OF MOLECULAR COMPLEXES OF THE METALLIC HALIDES OF GROUP II OF THE PERIODIC TABLE. S. R. Jain and S. Soundararajan (Indian Inst. of Science, Bangalore, India). J. Inorg. Nucl. Chem., 26: 1255-61(July 1964).

Dielectric measurements were made on a number of molecular complexes of beryllium, zinc, cadmium, and mercuric halides. The polarizations observed were interpreted in terms of a tetrahedral configuration for the undissociated beryllium, zinc and cadmium halide complexes. In other cases the observed polarization was found to be due to the dissociation of the complex in solution. (auth)

31488 THE EXTRACTION OF URANIUM(VI) FROM NITRIC ACID SOLUTIONS BY TRI-n-OCTYLAMINE. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Inorg. Nucl. Chem., 26: 1295-1300(July 1964).

The partition of uranium(VI) between nitric acid solutions and solutions of tri-n-octylamine (TOA) in benzene was investigated under different conditions, and infra-red studies were made of the organic phase. (auth)

31489 MECHANISM OF EXTRACTION OF PLUTONIUM (IV) IN ORGANIC SOLVENTS. T. S. Laxminarayanan, S. K. Patil, and H. D. Sharma (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 26: 1301-9 (July 1964).

The mechanism of extraction of plutonium(IV) in tri-n-butyl phosphate (TBP), methyl isobutyl ketone (hexone), and di-ethylene glycol di-butyl ether (butex) was studied by the method of two phase equilibria varying the concentrations of nitrate and hydrogen ion in the aqueous phase. The results show that plutonium(IV) is associated with an average of 2.6 nitrate ions in aqueous phase over a concentration range of 2–4M nitrate ions. Furthermore plutonium(IV) in and up to 6.7M nitrate concentration is extracted as $Pu(NO_3)_4$ in hexone and butex and thereafter adds on HNO_3 in the organic phase to form $H_2Pu(NO_3)_6$. This is supported by the evidence obtained by studying the absorption spectra of solutions both in the aqueous and organic phases. (auth)

31490 VIBRATIONAL DISPLACEMENTS OF ATOMS AND THE ISOTOPE EFFECTS ON VIBRATIONAL FREQUENCIES. Tatsuo Miyazawa (Osaka Univ.). J. Mol. Spectry., 13: 321-5(July 1964).

The isotope effects upon vibrational frequencies may be expressed in terms of the atomic displacements (L^X matrix). The frequency shifts for diborane ($B^{11} \rightarrow B^{10}$) and for polyglycine ($N^{14} \rightarrow N^{15}$) were calculated. From the experimental isotope effects, the normalized absolute values of the vibrational amplitudes may be calculated and may be referred to in the refinements of vibrational potential functions. (auth)

31491 THE ORIGIN OF THE ISOTOPE EFFECT ON THE ACID DISSOCIATION CONSTANTS OF AQUO METAL IONS. R. Stuart Tobias and M. Yasuda (Univ. of Minnesota, Minneapolis). J. Phys. Chem., 68: 1820-8(July 1964).

Values are reported for the acid dissociation constants of the aquotriethyltin(IV) ion in protium and deuterium oxide and for the aquodimethyltin(IV) ion in D_2O. The latter values were compared to those reported earlier for H_2O. All of the data are for media 3 M in ClO_4^-. The values of the isotope effect on the single dissociation constant of the aquotriethyltin(IV) ion and on both the first and second dissociation constants of the aquodimethyltin(IV) ion are at least as large as found for phenols and carboxylic acids of comparable strength and have the values log $(K_H/K_D) = 0.69$, 0.4–0.5, and 0.65–0.67, respectively. In the dimethyltin case, the values vary somewhat depending upon which polycondensed species are assumed to exist in highly hydrolyzed solutions. The model of Bunton and Shiner for acid–solvent hydrogen bonding was employed to estimate the isotope effect with aquo acids, and it is suggested that these large isotope effects may arise from the inability of the aquo cations to hydrogen bond effectively with the solvent. Since with $[Fe(OH_2)_6]^{3+}$ and $[(OH_2)_5CoOH_2]^{3+}$ ions all of the hydrogen in aquo and ammine groups exchanges with solvent hydrogen, the small isotope effect appears to result from an increase in the zero point vibrational energy of these hydrogen–nitrogen and oxygen bonds in the conjugate base over that in the acid. Evidence for this is presented in terms of the vibrational frequencies of the coordination compounds. It appears possible that the equilibrium isotope effect like its kinetic counterpart may prove useful in determining the proper reaction schemes in systems involving complicated proton transfer and condensation equilibria. The reliability of the glass electrode for measurements in D_2O solutions was also examined. (P.C.H.)

31492 DIFFUSION OF UNLIKE IONS INTO LIQUID SODIUM CHLORIDE. J. O'M. Bockris, S. Yoshikawa, and S. R. Richards (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem., 68: 1838-41(July 1964).

The diffusion coefficients (D) of dilute amounts of Li (<1 mole %) and ^{22}Na, ^{42}K, ^{86}Rb, ^{134}Cs ($<10^{-2}$ mole %) into molten NaCl were measured as a function of temperature. The value of D at a given temperature decreases with increasing ion size and the energies of activation for diffusion increase with increasing ion size. This is due to the increasing effect of the heat of activation for jumping, with increase of ion size, compared with that associated with the work of forming a hole. (auth)

31493 THE VOLATILIZATION OF TUNGSTEN IN THE PRESENCE OF WATER VAPOR. G. R. Belton and R. L. McCarron (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem., 68: 1852-6(July 1964).

A study was made, using the transpiration technique, of the enhanced volatility of tungsten in mixtures of hydrogen and water vapor. The volatilization is shown to occur by the reaction $W(s) + 4H_2O(g) = WO_3H_2O(g) + 3H_2(g)$. The standard free energy change for the reaction between 1200 and 1500°C is given by: $\Delta F^\circ = 26{,}700 - 5.56T$ cal. (auth)

31494 ION-EXCHANGE STUDIES IN CONCENTRATED SOLUTIONS. III. THE NATURE OF THE RESIN SULFONATE-CATION BOND IN STRONG ACID SOLU-

TIONS. D. C. Whitney and R. M. Diamond (Univ. of California, Berkeley). J. Phys. Chem., 68: 1886-90(July 1964). (UCRL-10935)

A study was made of the cation exchange of two labile ions, Fe(III) and Sc(III), and one nonlabile ion, Cr(III), between strong acid solutions and both a sulfonic acid resin and a sulfonic acid liquid ion exchanger. The differences in exchange behavior in concentrated solutions are interpreted in terms of the differences in lability of the ions. The nature of the resin sulfonate ion bond for both dilute and concentrated aqueous acid solutions is discussed. (auth)

31495 PARTITION OF SOLUTES BETWEEN LIQUID METALS. II. THE LEAD–ZINC SYSTEM. Fred A. Cafasso, Harold M. Feder, and Irving Johnson (Argonne National Lab., Ill.). J. Phys. Chem., 68: 1944-8(July 1964).

The partition coefficients of palladium, uranium, plutonium, cerium, and strontium between liquid lead and zinc were measured from 650 to 765°C. At 703°C, a temperature of measurement common to all the solutes, the partition coefficients were found to be 200, 21.5, 7.3, 3.4, and 0.05 (atom fraction in zinc/atom fraction in lead), respectively. An approximate equation that connects partition coefficients measured between two partially miscible solvents to activity coefficients measured in the pure solvents was used to calculate coefficients for the partition of uranium between liquid lead and zinc. Good agreement was obtained between the partition coefficients that were calculated and measured. With the aid of this equation, estimates of the activity coefficients (γ) of cerium and plutonium in liquid lead were made from the partition data. At 703°C, γ (Ce) = 4.7×10^{-7} and γ (Pu) = 7.1×10^{-4}. The mutual solubilities of lead and zinc were also measured from 650 to 795°C. (auth)

31496 DISSOCIATION ENERGIES OF ALKALINE EARTH OXIDES. M. S. Chandrasekharaiah (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 2020-1 (July 1964). (BNL-7654)

The dissociation energies of alkaline earth oxides were estimated on the basis of a simple ionic model. An ionic model consisting of M^{2+} ion and O^{2-} ion separated by the equilibrium internuclear distance is assumed for the molecules, and the binding energies were calculated. Except for MgO, the agreement with experimental values was reasonable. This indicates that the bonding in MgO is not as ionic as the other three, or the molecular parameters available are in gross error. (P.C.H.)

31497 THE THERMAL CONDUCTIVITY OF HYDROGEN–HELIUM MIXTURES. Robert S. Hansen, Robert R. Frost, and James A. Murphy (Ames Lab., Ames, Iowa). J. Phys. Chem., 68: 2028-9(July 1964). (IS-829)

Instrumental response was used to interpolate reciprocal thermal conductivities of H–He mixtures between values for pure hydrogen and pure helium on a linear basis. Thermal conductivities of H (component 1)–He (component 2) mixtures were calculated at 273.16°K. Equations were programmed for computer calculation and thermal conductivities calculated at 0.02 mole fraction increments over the entire composition range. Values observed were always somewhat higher than theoretical, but the maximum deviation was 1% and the trend of results was very much in accord with theory. A definite minimum was evident at a hydrogen mole fraction of 0.13. Chromatographic behavior (using the conventional thermal conductivity detection instrumentation) can thus be described in terms of the theoretical curve. (P.C.H.)

31498 THE PRODUCTION OF CARRIER-FREE Co^{57} SOURCES FOR INVESTIGATION OF THE MÖSSBAUER EFFECT. J. Bara, A. Z. Hrynkiewicz, and I. Stronski (Inst. for Nuclear Physics, Krakow and Jagellonian Univ., Krakow). Kernenergie, 7: 317-19(May 1964). (In German)

A method is described for the preparation of carrier-free ^{57}Co sources. The procedure involves cyclotron-irradiation of spectrally-pure iron in a water-cooled copper block in the presence of an oxidizing agent such as bromine or hydrogen peroxide. The crude product is purified on an ion-exchange column packed with the strongly alkaline exchanger ASD-2 and Dowex-1X8, respectively. The procedure is repeated one or more times until the desired degree of purity is attained. The purified product is suitable for investigations of the Mössbauer effect, a phenomenon in the field of relativity. (OTS)

31499 NOTES TO THE CRITICAL REMARKS OF ZOLTAN SZABO AND BELA LAKATOS ON THE PROBLEM OF CIS- AND TRANS-URANIDES. M. Haissinsky (Faculte des Sciences, Paris). Magy. Tud. Akad. Kem. Tud. Oszt. Kozlemen., 21: 187-90(1964). (In Hungarian)

Some critical remarks due to a misunderstanding and differences in language (17: 6091), on a study of cis- and trans-uranides (17: 6090), are corrected. It was stated that the seventh period elements were not classified into two categories chemically, i.e., cis- and trans-uranides. These categories were merely used in the topologic sense. It was not suggested that neptunium, plutonium, and americium are homologous with the third triad of the VIII column of the periodic classification. They were considered as uranides. The periodic table, which was published, was developed to be considered chemically and not from the standpoint of electronic structure. The classification of the elements in relation to the atomic structure according to Paneth is outlined and discussed. It is suggested that the lanthanides should be in the sixth period and uranides in the seventh, divided into uranides (U-Am) and curides (Cm-Lw). It was concluded that this would avoid the rigid classification of elements as indicated by the grouping according to actinides and would better reflect the chemical characteristics of the period structure. (BBB)

31500 CO-ORDINATION SEVEN OF URANIUM IN URANYL-ACETYLACETONATE MONOHYDRATE. Edoardo Frasson, Gabriella Bombieri, and Carlo Panattoni (Centro di Strutturistica Chimica del Consiglio Nazionale delle Ricerche, Padua). Nature, 202: 1325-6(June 27, 1964).

The molecular structure of uranyl-acetylacetonate monohydrate was investigated by x-ray diffraction. The uranium in this compound exhibits a co-ordination number of seven. The geometry of the co-ordination is that of a pentagonal bipyramid with seven oxygen atoms localized at the corners. The pentagonal basis of the bipyramid is given by the four oxygens belonging to the chelate rings and the oxygen of the water molecule. The uranyl group is linear and normal to the plane of the other oxygen atoms. The U–O bond lengths were also determined. (C.E.S.)

31501 DECOMPOSITION OF MOLYBDENUM HEXACARBONYL. I. F. Ferguson (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.), J. B. Ainscoigh, D. Morse, and A. W. Miller. Nature, 202: 1327-8 (June 27, 1964).

Hydrogen at a pressure of 0.15 torr was passed over molybdenum hexacarbonyl at 20°C to give a total pressure of 0.30 to 0.35 torr. The gas stream was led into a Pyrex tube maintained at 300°C where the hexacarbonyl decom-

posed to give an apparently metallic deposit. X-ray powder diffraction analysis showed that the product consisted of a single, strained, fcc phase with a cube cell edge between 4.15 and 4.18 Å, which was indistinguishable from γ-Mo_2N. Chemical analyses were made absorptiometrically for molybdenum, for carbon by combustion, and for nitrogen, oxygen, and hydrogen by micro vacuum fusion. It is shown that molybdenum hexacarbonyl may be pyrolyzed to give a range of oxycarbides. (C.E.S.)

31502 INVESTIGATION OF THE ELECTRIC AND MAGNETIC SERIES IN THE LUMINESCENCE SPECTRA OF ALKALI FLUORIDES ACTIVATED BY HEXAVALENT URANIUM. A. M. Kaplyanskii, N. A. Moskvin, and P. P. Feofilov. Opt. Spectry. (USSR) (English Transl.), 16: 339-43(Apr. 1964). Translated from Optika i Spektroskopiya, 16: 619-27(Apr. 1964).

The dependence of the degree of polarization of the luminescence of LiF and NaF crystals activated by ^{6+}U on the wavelength of the exciting light was investigated. A qualitative mirror symmetry of the curves $P(\lambda_{exc})$ was found for the electric and magnetic series in the luminescence spectra, which is evidence of the common nature of the centers emitting these series. It is shown that the distribution of intensity in the electronic-vibrational spectra of luminescence agrees with theoretical expectations. The temperature shift of the lines in the luminescence spectra is due to the change in the parameters of the crystal lattice. The temperature dependence of the intensity of the two series was investigated; on this basis the level scheme of the luminescence centers was constructed. (auth)

31503 THERMOLUMINESCENCE OF ACTIVATED CaF_2, SrF_2, AND BaF_2 SINGLE CRYSTALS. I. CLASSIFICATION OF THE CAPTURE LEVELS AND THE RECOMBINATION NATURE OF THERMOLUMINESCENCE. V. V. Arkhangelskaya. Opt. Spectry. (USSR) (English Transl.), 16: 343-8(Apr. 1964). Translated from Optika i Spektroskopiya, 16: 628-37(Apr. 1964).

A study was made on the thermoluminescence of CaF_2, SrF_2, and BaF_2 single crystals activated by Er^{3+}, Ho^{3+}, Tm^{3+}, and Dy^{3+}. The afterglow was shown to have a recombination nature. Activator capture levels were discovered along with the capture levels due to thermal microdefects of the host lattice. (auth)

31504 MAGNETIC SHIELDING TRANSITION IN SOLID CeF_4. M. Pintar (Nuclear Institute "J. Stefan," Ljubljana, Yugoslavia). Phys. Letters, 10: 265-6(June 15, 1964).

Observation of a symmetric F^{19} NMR absorption line at temperatures from 125 to 287°K, which is independent of both the temperature and the magnetic field, is reported. The line width and the second moment of the absorption line in this temperature range was found to be 7.2 gauss and 9.6 G^2, respectively. The temperature and field dependence of the line width above the transition temperature are also discussed. (L.B.S.)

31505 PARAMAGNETIC RESONANCE OF TRIVALENT YTTERBIUM IONS IN CALCIUM TUNGSTATE. J. Kirton and R. C. Newman (Associated Electrical Industries, Inc., Rugby, Warwickshire, Eng.). Phys. Letters, 10: 277-8 (June 15, 1964).

Results of paramagnetic resonance studies of calcium tungstate doped with small amounts of ytterbium and sodium are presented. Measurements made at 4.2°K and X-band microwave frequencies are fitted to the spin hamiltonian, and the resulting g-values and eigenvectors are tabulated. (L.B.S.)

31506 LATTICE VIBRATIONS IN DIAMOND. J. L. Yarnell, J. L. Warren, and R. G. Wenzel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 13: 13-15 (July 6, 1964). (LADC-6448)

Measurements of transverse acoustic dispersion curves for lattice vibrations propagating in the (100) and (111) directions in diamond are reported. The method of inelastic scattering of slow neutrons was used. Observed dispersion curves are in good agreement with those inferred from specific-heat and infrared absorption measurements but disagree with those deduced by assuming that diamond is homologous to silicon and germanium. (M.J.T.)

31507 THEORY OF DIFFUSE SCATTERING OF X-RAYS BY A MOLECULAR CRYSTAL. W. Cochran and G. S. Pawley (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 280: 1-22(July 7, 1964).

The theory of diffuse x-ray scattering by a molecular crystal is given, it being stressed that the modes of vibration causing scattering are in general mixed translational and librational. The theory is applied to an idealized model of hexamethylenetetramine, making use of the elastic constants and the Raman frequency to determine some of the molecular interaction constants. Dispersion curves are calculated from which frequency distributions are obtained. These compare well with experimental data. The thermal diffuse scattering is calculated and compared with experiment, and with the predictions of more approximate theories. The similarity between all of these suggests that very careful measurement of x-ray intensities will be necessary before conclusions can be drawn about intermolecular forces in crystals. (auth)

31508 STACKING FAULTS IN URANIUM DIOXIDE. K. H. G. Ashbee (Central Electricity Generating Board, Berkeley, Gloucester, Eng.). Proc. Roy. Soc. (London), Ser. A, 280: 37-46(July 7, 1964).

Specimens of uranium dioxide were quenched in an arc furnace from temperatures just below the melting point, cut into slices, and chemically thinned for examination by transmission electron microscopy. Defects in the form of stacking faults and tetrahedra were observed. Complete contrast experiments were successfully carried out on some of these stacking faults and reveal a $\frac{1}{6}$[121] displacement vector lying in the fault plane. The (111) and (201) stacking fault planes were identified, and it is thought that many more stacking fault planes exist having the displacement vector as zone axis. A combination of dark-field and bright-field microscopy shows that the faults are intrinsic. The tetrahedra are thought to be stacking faults lying on all four {111} planes and are attributed to dissociation of Frank sessile loops formed by vacancy condensation on {111} planes. (auth)

31509 CRYOSCOPIC INVESTIGATIONS ON URANIUM(IV) CHLORIDE AND FLUORIDE IN THE FUSED LiCl–KCl EUTECTIC. Aleksander Bogacz and Wlodzimierz Trzebiatowski (Technical Univ., Wroclaw, Poland). Roczniki Chem., 38: 723-8(1964).

Corresponding freezing point depressions were measured to obtain data on the ionic structure of dilute UCl_4 and UF_4 solutions in a pure LiCl–KCl eutectic melt or in a eutectic containing some small quantities of LiF and KF. (auth)

31510 THERMODYNAMIC CHARACTERISTICS OF URANIUM(IV) CHLORIDE IN MELTS WITH ALKALI CHLORIDES BASED ON PHASE DIAGRAMS. Aleksander Bogacz and Wlodzimierz Trzebiatowski (Technical Univ., Wroclaw, Poland). Roczniki Chem., 38: 729-44(1964).

Based on the binary phase diagrams examined for the systems composed of UCl_4 and LiCl, NaCl, KCl, RbCl, or CsCl as well as on values of heat of fusion of alkali chlorides and UCl_4 determined or checked by the cryoscopic

method the thermodynamic properties of liquid uranium tetrachloride melts with alkali chlorides are given. (auth)

31511 STUDIES ON GRAFT POLYMERIZATION TO COTTON. VIII. GRAFT POLYMERIZATION OF STYRENE TO COTTON IMBIBING SOLUTIONS OF CATALYSTS. I. Sakurada and Y. Sakaguchi. Seni-i Gakkaishi, 19: 217-21(Mar. 1963). (In Japanese)

Cotton fabrics imbibing aqueous solutions of potassium persulfate (KPS), ammonium peroxide (APS), and H_2O_2, or methanol solutions of azobisisobutyronitrile and benzoyl peroxide (BPO) were heated with styrene in sealed tubes. The effects of various factors such as the compositions and the quantities of imbibed solutions and atmosphere, temperature and time of heating on the graft polymerization were examined. Results indicated that KPS offered the most suitable conditions. The behavior of the graft polymerization generally resembled that of grafting by a simultaneous irradiation method. (OID)

31512 FRAGMENT IONS WITH EXCESS KINETIC ENERGY PRODUCED BY ELECTRON IMPACT. PART I. METHODS OF MEASUREMENTS AND M/E IONS FROM 1,3-BUTADIENE. Toshikazu Tsuchiya (Government Chemical and Industrial Research Inst., Tokyo). Shitsuryo Bunseki, 11: 100-5(Oct. 1963). (In Japanese)

A method is described for measuring high-energy ions with a conventional analytical mass spectrometer without equipment such as an additional deflecting electrode or a metastable ion suppressor slit, and some results are given. (auth)

31513 THE ATOMIC ABSORPTION SPECTRA OF THE LANTHANIDE ELEMENTS. Victor G. Mossotti and Velmer A. Fassel (Ames Lab., Ames, Iowa). Spectrochim. Acta, 20: 1117-27(July 1964). (IS-790)

Atomic absorption spectra of the lanthanide elements can be observed in fuel-rich, oxyacetylene flames fed with ethanolic solutions of perchlorate salts of these elements. More than 1000 lines were observed in the 2500–6500 Å region, many of which are of sufficient intensity for analytical determination by atomic absorption spectrometric techniques. The wavelengths of the observed lines serve as a convenient starting point for deducing the low lying energy level structures of those systems, which are still not analyzed. (auth)

31514 PREPARATIONS AND PROPERTIES OF LANTHANUM NITRIDES. M. D. Lyutaya and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 29: 251-5 (1963). (In Ukrainian)

Preparations of lanthanum nitrides and their chemical properties are described. Reactions of metallic lanthanum (98.5% La with Ce impurity) with nitrogen and ammonia to form lanthanum nitrides were investigated. Experiments showed a low chemical resistance of LaN in the air, acid, and alkali solution and high stability in Ar, N, and CO_2. (R.V.J.)

31515 STUDIES OF SCANDIUM OXALATES. L. I. Dubovenko (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 29: 698-702(1963). (In Russian)

Spectrophotometric and ion electro-migration methods were used for determining the stability and composition of scandium oxalate complexes in solutions of various pH. The complex ions $ScC_2O_4^+$ and $Sc(C_2O_4)_2^-$ were prepared with pH ≤ 2 and pH ≈ 5, respectively. The dissociation constant of the complex cation was determined by means of light absorption in the ultraviolet and by equilibrium with oxalate and thiocyanate iron complexes. The mean K_1 value for both methods is 9.7×10^{-9}. The total dissociation constant for $Sc(C_2O_4)_2^-$ is 1.51×10^{-15}. Stepwise dissociation constants for the di- and tri-oxalate complex ions, estimated on the basis of experimental data for pK_1 and theoretical correlations for the stepwise dissociation constants, were found to equal $pK_2 = 5.37$ and $pK_3 = 1.44$. (R.V.J.)

31516 SORPTION OF RARE EARTH CATIONS BY CATIONITES. II. KINETICS OF RARE EARTH CATION SORPTION FROM DILUTE SOLUTIONS BY Ku-2 CATIONITE IN ACID. M. E. Kornelli and I. A. Legenchenko. Ukr. Khim. Zh., 29: 709-14(1963). (In Russian)

The kinetics of the sorption of Ga, La, and Nd from dilute solutions by the hydrogen form of cationite Ku-2 revealed a linear dependence of the sorption rate on the concentration of solutions. An equation describing the rate of sorption was used for determining the rate coefficient and the apparent activation energy. The appearance of the kinetic equation, the apparent activation energy and the dependence of the rate of sorption on the size of the grain led to the postulation that the sorption is accomplished by external diffusion. The sorption kinetics for Gd, La, and Nd are almost identical. (R.V.J.)

31517 ANODIC SOLUTION OF ZIRCONIUM IN FUSED EQUIMOLAR MIXTURE OF POTASSIUM AND SODIUM CHLORIDES. I. N. Sheiko, T. N. Grechina, and V. T. Barchuck (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 29: 722-6 (1963). (In Russian)

The anodic solution of zirconium in a molten equimolar mixture of potassium and sodium chlorides was studied at various current densities and at temperatures from 700 to 720° with a low current density (0.05 to 0.1 amp/cm²) zirconium dissolves by transforming into the divalent form. The mean valence of zirconium rises with the current density; at a current density 2 amp/cm² and over it transforms into a tetravalent element. Divalent zirconium chloride does not concentrate in the melt but disproportionates into zirconium tetrachloride and metal. Zirconium dichloride in equilibrium with the metal can be found only on the surface of a highly dispersing metallic zirconium. (R.V.J.)

31518 REACTION OF YTTRIUM WITH ALIZARIN S AND AMMONIA. L. S. Serdyuk and U. F. Silich (Dnepropetrovsk State Univ., USSR). Ukr. Khim. Zh., 29: 848-54 (1963). (In Russian)

Studies of yttrium complexing with Alizarin S and ammonia showed that it forms complex coordinate compounds of yttrium alizarinate and ammonium alizarinate. The reaction follows a stepwise pattern forming first the compound $YAliz_3 \cdot 2NH_4$ Aliz then, with an increase of Alizarin S, $YAliz_3 \cdot 5NH_4$Aliz. The ratio of reacting component was determined by the molar ratio method, isomolar series, and equilibrium shift. (R.V.J.)

31519 ON THORIUM PHOSPHOMOLYBDATE AND CERIUM PHOSPHOMOLYBDATE HETEROPOLYCOMPLEXES. Yu. F. Shkarvoskii (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 241-3(1964). (In Russian)

Reactions of thorium and cerium(IV) with phosphomolybdate complexes in acid solutions formed ternary compounds of thorium phosphomolybdates and cerium phosphomolybdates which could not be crystallized. A physicochemical analysis was made of the ingredients of the solution prepared and spectrophotometric graphs for cerium and thorium heteropolycomplexes were developed

as functions of cerium, thorium and phosphorus concentration in the complexes. (R.V.J.)

31520 DETERMINATION OF REFRACTIVE INDICES FOR ZIRCONIUM AND HAFNIUM SULFATES IN WATER AND IN DILUTE SULFURIC ACID. E. I. Kovaleva and I. V. Vinarov (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 132-7(1964). (In Russian)

Refractive indices were determined for zirconium and hafnium sulfates in water and in dilute sulfuric acid at 25 to 35°. The data were used for determination of the degree of hydrolysis of the above materials. Before hydrolysis the refractive indices for equal molar concentrations of zirconium and hafnium sulfate solutions are identical. The reaction of hydrolysis takes less time with low concentration of hafnium sulfates than with low concentration of zirconium sulfates. (R.V.J.)

31521 COMPLEXES OF RARE EARTHS WITH PYROCATECHOL AND PYROGALLOL IN ALKALI SOLUTIONS. K. V. Tserkasevich and N. S. Poluektov (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 146-51(1964). (In Russian)

Potentiometric and spectrophotometric studies showed that Nd, Er, and Ho form complexes with polyphenols (pyrocatechol and pyrogallol) in alkali solutions. The complexes are in the ratio 1:1 and 1:2, and are the result of complete solubility of polyphenol compounds and rare earths in alkali. The absorption spectra were studied at 560 to 605 mμ for Nd, 430 to 470 mμ for Ho, and 510 to 540 mμ for Er. Formulas of the compounds are presented. (R.V.J.)

31522 SORPTION OF RARE EARTH CATIONS BY CATIONITE. IV. EQUILIBRIUM BETWEEN RARE EARTH AND AMMONIUM AND SODIUM CATIONS IN THE SOLUTION SYSTEM–CATIONITE. M. E. Kornelli and I. A. Legenchenko (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 165-9(1964). (In Russian)

The isotherms constructed for Gd, Nd, and La ions indicated that the exchange equilibrium of lanthanides with univalent cations (Na^+, NH_4^+) on cationite Ku-2 is subordinate to the Nikol'skii isotherm in its simplest form. The exchange constants for Nd^{3+} and Gd^{3+} were almost identical but differed for La^{3+}. Exchange constants for lanthanides were higher in ammonium exchange than in sodium cation exchange. An increase in temperature of 25° increased the exchange by 6 to 15% without affecting the exchange volume. An increase of lanthanide concentration by 20-fold did not influence the equilibrium isotherm. (R.V.J.)

31523 DETERMINATION OF INSTABILITY CONSTANTS FOR LANTHANUM OXALATE COMPLEXES. L. I. Dubovenko and T. F. Zhulinskaya (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 228-32(1964). (In Russian)

An analysis was made of the properties of lanthanum oxalates. It was found that the solubility of lanthanum oxalate in various nitric acid concentrations at 17° and ionic strength of 0.5 was 1.5×10^{-26}. The equilibrium constant for the reaction $La_2(C_2O_4)_3 + La^3 \rightleftharpoons 3LaC_2O_4^+$ was calculated and the instability constant of $LaC_2O_4^+$ was found to be 1.3×10^{-6}. The solubility of lanthanum oxalate in ammonium oxalate solutions was studied at various concentrations of constant ionic strength and in solutions with almost identical pH. The equilibrium $La_2(C_2O_4)_3 + C_2O_4^{2-} \rightleftharpoons 2La(C_2O_4)_2^-$ was studied and complete instability constants for complex $La(C_2O_4)_2^-$ ions equal to 1.9×10^{-9} were calculated. For coordinately saturated complex ions, the complete instability constant is $K^{3-}_{La(C_2O_4)_3} = 2.2 \times 10^{-10}$. (R.V.J.)

31524 SYNTHETIC ELEMENTS. Glenn T. Seaborg and Arnold R. Fritsch (Atomic Energy Commission, Washington, D. C.). Umschau Wiss. Tech., 64: 321-4(June 1, 1964). (In German)

The methods used for the production and identification of the transuranium elements are briefly described. (J.S.R.)

31525 RARE EARTH HALIDES OF LOW OXIDATION. G. I. Novikov and O. G. Polyachenok (Leningrad State Univ.). Usp. Khim., 33: 732-47(June 1964). (In Russian)

A review is given of the low oxidation rare earths. Synthesis and properties of rare earth dihalides and oxychlorides and dissociation of samarium, europium, and ytterbium trichlorides are discussed. Phase diagrams, vapor pressure, and electric conductivity trichlorides of rare earth metals are analyzed and the stability of rare earth dihalides are estimated. 86 references are included. (R.V.J.)

31526 NUCLEAR-RESONANCE GENERATOR WITH FLOWING LIQUID. F. I. Skripov. Vestn. Leningr. Univ., No. 6, Ser. Fiz. i Khim., No. 1, 26-52(1964). (In Russian)

A theory of the operation of the nuclear-resonance generator in the earth's magnetic field is given. The Packard-Varian theory is reviewed and found to be deficient for continuous measurement of fields. A new method is discussed which is based on a nuclear-resonance generator with continuous polarization of a flowing liquid (water in this case). The water flows through a magnetizing (polarization) coil of strength H which induces a nuclear magnetization M in the fluid proportional to field strength $H_0 + H^*(H_0 - \text{terrestrial field})$. The liquid then flows through a tube into a phasing (cohering) coil which creates an alternating field at resonance frequencies. A mock-up test is described with a flow rate of 100 cm^3 per sec and H = 400 gauss. A similar instrument utilizing the Overhauser nuclear polarization method is also discussed. Theoretical expressions are obtained for the magnetizing and cohering coils. A simplified form for nuclear magnetization in a time interval $0 < t < \tau_H$ is given. The characteristics of the generator in the narrow band filter regime are studied in detail and given as two mathematical expressions. The discussion is extended to include nonhomogeneity effects in H_0. (OTS)

31527 THE SPECTROPHOTOMETRIC STUDY OF ASCORBIC COMPLEXES. K. P. Stolyarov and I. A. Amantova. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 132-41(1964). (In Russian)

The formation of ascorbic complexes of the elements of the second and third groups of the periodic system (Excluding strontium and mercury) causes variations in the absorption spectra of simple salt solutions: the maxima of light absorption increase and sometimes shift into long wave region (Pr, Nd, Ho, Er); there increases absorption in the 320–340 mμ region associated with the displacement of the absorption band of ascorbic acid into long wave region (Zn, Cd and elements of the third group, excluding B); obtained for some elements are negative values of optical density in the λ = 320–370 mμ region, i.e. light absorption decreases (Be, Zn, Cd, B, Al, Sc, Y, La, Tb, Dy, Ho, Er, Lu); there appear new maxima (Mg 320–340 mμ; Ca and Ba 345 mμ; Zn and Cd 390 mμ). (auth)

31528 THE FERROMAGNETISM OF HEXAGONAL FERRITE, INVESTIGATED WITH THE MÖSSBAUER EFFECT. Werner Zinn (Siemens and Halske AG, Munich),

Stefan Huefner, Michael Kalvius, Paul Kienle, and Werner Wiedemann. Z. Angew. Phys., 17: 147-53(Apr. 1964). (In German)

The hyperfine structure of the nuclear resonance line of ^{57}Fe caused by the Zeeman effect and electric quadrupole resonance splitting was investigated on polycrystalline and single crystal samples of barium ferrite ($BaO \cdot 6Fe_2O_3$) and magnetoplumbite ($PbO \cdot \underline{x}\ Fe_2O_3$) in the temperature range from 15 to 850°K with the Mössbauer method. The temperature dependence of the magnetic moments of two equally frequent groups of ferric ions could be determined. By superposition of an exterior magnetic field of 25 kOe, it was possible to classify both these groups into five magnetic sublattices according to the crystal structure to be expected. Their moment classification was determined. The temperature dependence of the saturation magnetization of the hexagonal ferrites could be interpreted by compilation of the results. (tr-auth)

31529 CONTRIBUTIONS TO THE CHEMISTRY OF NIOBIUM AND TANTALUM. PART 34. FORMATION ENTHALPHY OF NbO AND $NbOCl_2$. Harald Schafer and Franz Liedmeier (Universität, Munster, Ger.). Z. Anorg. Allgem. Chem., 329: 225-8(May 1964).

The formation enthalpy of NbO and $NbOCl_2$ was determined by reacting them with chlorine gas in a bomb calorimeter. The reaction product was $NbOCl_3$ for both compounds. The results were -97 ± 1 kilocalories and $-185 + 1$ kilocalories, respectively. (OTS)

31530 ELECTRON SPIN RESONANCE OF NITROGEN CENTERS IN ALKALI HALIDE CRYSTALS. A. Hausmann, R. Hilsch, and W. Sander (Universitat, Gottingen, Ger.). Z. Physik, 179: 461-7(1964). (In German)

Paramagnetic nitrogen centers were produced in nitrate-doped single crystals of KCl, KBr, KI, and NaCl by introduction of F-centers. The electron spin resonance was studied at low temperature. The hyperfine structure of the lines was caused by interaction with two ^{14}N nuclei. The angle dependence of the resonance spectra was measured by rotating the crystals about several crystallographic axes. The results could be fitted to a spin-Hamiltonian with orthorhombic symmetry. The components of the g-tensor and the A-tensor were determined. The centers were believed to be N_2^--ions in negative ion vacancies. (auth)

31531 AN APPARATUS FOR THE EVAPORATION OF HIGH-MELTING ALKALINE EARTH CHALKS. G. Berthold and H. Mittendorf (Universität, Gottingen, Ger.). Z. Physik, 179: 468-72(1964). (In German)

An apparatus is described, which permits evaporation of nonconducting substances with high melting points by electron bombardment. (M.C.G.)

31532 THE INFRARED SPECTRUM OF SOLUTIONS OF DCl AND NaOD IN HEAVY WATER. Th. Ackermann (Universitat, Munster, Ger.). Z. Physik. Chem. (Frankfurt), 41: 113-15(Apr. 1964). (In German)

The absorption spectra of solutions of DCl or NaOD in D_2O were measured at wave lengths from 3 to 9 μ. The extinction coefficients of the solutions were also determined as a function of the wavelength. The results are graphed and show that the continuous supplementary absorption is in both cases completely analogous to that found in aqueous acid and alkali hydroxide solutions. The origin of the continuous absorption is also in a delocalization of the positive or negative excess charge in the solvate complexes of the dissolved D^+ or OD^- ions. No isotope effects was detected in the intensity of the supplementary absorption. (J.S.R.)

31533 MASS SPECTROMETRIC INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF THE SYSTEM $NaF-ZrF_4$. [PART] II. L. N. Sidorov, P. A. Akishin, V. I. Belousov, and V. V. Shol'ts (Moscow State Univ.). Zh. Fiz. Khim., 38: 1173-81(May 1964). (In Russian)

A mass spectrometric method for determining partial pressures from the total vaporization isotherms is described. The complete mass spectrum of the positive molecular ions and the relative ionization cross sections of the molecules, NaF, ZrF_4, and $NaZrF_5$ were determined. The composition-partial pressure diagrams of NaF, Na_2F_2, ZrF_4, and $NaZrF_5$ are given and the enthalpies of dissociation of the molecules Na_2F_2 and $NaZrF_5$ were determined. It was found that under the conditions of molecular inflow, the system $NaF-ZrF_4$ is distilled in a vacuum without change in composition of the condensate and with the overall pressure in the system differing from the extreme pressure possible. (auth)

31534 DETERMINATION OF THE ORDER OF THE H–D EXCHANGE REACTION BETWEEN ETHYLENE AND DEUTERIUM ON γ ALUMINUM OXIDE. A. I. Trokhimets and S. V. Markevich (Inst. of Physico-Organic Chemistry, Academy of Sciences, Belorussian SSR). Zh. Fiz. Khim., 38: 1293-1300(May 1964). (In Russian)

The H–D exchange reaction in ethylene on $\gamma-Al_2O_3$ follows the order of replacement of a hydrogen atom by deuterium, so that the more deuterated ethylenes are produced by a multiple transformation of the same molecule. The isotopic exchange activation energy (determined on the basis of the rate constants as functions of temperature) was equal to 5.2 kcal. (R.V.J.)

31535 REDUCTION OF β-URANIUM DIOXIDE BY SOLID CARBON. V. G. Vlasov and E. V. Tkachenko. Zh. Prikl. Khim., 37: 946-51(May 1964). (In Russian)

Kinetic and x-ray investigations were made of the reduction of β-uranium dioxide by solid carbon (acetylene black) at 700 to 900°C. The phase transformation followed the following scheme: $U_4O_9 \rightarrow UO_{2+x_{max}} \rightarrow UO_{2+x}$. (R.V.J.)

31536 RADIOMETRIC METHOD OF INVESTIGATION OF CHLORINATION KINETICS AND MECHANISM. Ya. Zenkevich and A. V. Lapitskii. Zh. Prikl. Khim., 1238-42(June 1964). (In Russian)

The kinetics of reaction in chlorination process were studied by a new radiometric method using ^{36}Cl. The method enables constant observation of reactions between the gas and solid or liquid phases. The method is limited by the low vapor elasticity of the initial substance and reaction products. (R.V.J.)

31537 A REVIEW OF DATA ON ELECTROCHEMISTRY OF MOLTEN SALTS FOR 1963. A. G. Morachevskii and B. V. Patrov. Zh. Prikl. Khim., 37: 1396-1408(June 1964). (In Russian)

Data on the electrochemistry of molten salts published during the year of 1963 are reviewed. The review covers the investigations of electric conductivity and transmission, electromotive forces, electrodes, binary electric layers of molten salts, metal–salt systems, electrolytic preparation of aluminum, magnesium, and alkali metals, electrolysis with liquid cathodes, preparation of solid materials on a cathode, and galvanic coating and corrosion. A list of 266 references is included. (R.V.J.)

31538 HIGHER IONIZATION POTENTIALS MEASURED BY ELECTRON IMPACT. H. Sjoegren (Royal Inst. of Tech., Stockholm). p.474-7 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

In an apparatus consisting of a Fox electron gun and an

ionization chamber, ionization efficiency curves were obtained for some gases. The breaks in these curves correspond to higher ionization potentials of the molecular ion. For methanol essentially the same values as J. Collin obtained by electron impact in a mass-spectrometer were found. This is surprising since, according to the breakdown curves O. Wilmenius and E. Lindholm obtained by charge exchange, the CH_3OH^+ ion breaks down completely at about 12 ev. The only possible explanation seems to be that ion impact and electron impact processes give ions with different degrees of stability. (auth)

31539 KINETICS OF HOT-ATOM CHEMICAL REACTION: EVALUATION OF AVERAGE COLLISIONAL ENERGY LOSS. R. Wolfgang (Yale Univ., New Haven). p.983-7 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The kinetics of chemical reactions of high translational energy atoms undergoing moderating collisions were further developed. It is shown that data on the total probability that a hot atom enters chemical combination as a result of such collision can be used to evaluate: The probability of reaction on collision, integrated over the logarithm of the energy. The average energy loss in interactions in which the hot atom does not combine. The expressions developed are applied to preliminary data on the reaction of recoil hydrogen atoms with CH_4 and recoil fluorine atoms with CF_4. It appears that in the relevant energy range (of the order of 3–10 ev) atomic collisions with polyatomic molecules are very inelastic, with the incident atom losing the major part of its kinetic energy in most collisions. The significance of this finding for the mechanism of hot-atom chemical processes is discussed. (auth)

31540 PRODUCTION OF URANOUS OXIDE. (to W. R. Grace & Co.). British Patent 963,352. July 8, 1964. Priority date Feb. 28, 1962, United States.

A process for the production of uranous oxide in a form suitable for dispersion as a sol, which comprises autoclaving a solution of uranous oxychloride, oxybromide, oxyacetate or oxyformate, or two or more of these, at 100 to 200°C, is described. Examples of the procedure are given. (L.B.S.)

31541 DEVICE FOR THE PRODUCTION OF PURE URANIUM TETRAFLUORIDE. Maurice Delange, Henri Huet, and Paul Vertes (to Commissariat à l'Energie Atomique). German Patent 1,165,001. Mar. 12, 1964. Priority date Apr. 20, 1960, France.

A reduction chamber and at least one succeeding chamber for fluoridization make up the device for UF_4 production. The tube connecting the vertically arranged chambers is of such length that rising vapors are absorbed by the down gliding material before they are able to enter the reaction chamber. (Gmelin Inst)

31542 METHOD FOR THE PRODUCTION OF ALUMINUM–URANIUM ALLOYS. Raymond Hugh Moore (to U. S. Atomic Energy Commission). German Patent 1,165,279. Mar. 12, 1964. Priority date Apr. 20, 1961, United States.

A uranium halide, e.g., uranium chloride, or a uranium oxide is processed in a melt of a nearly equimolar mixture of alkaline halogenide and aluminum halogenide. Aluminum in excess of the quantity necessary for the reduction of the uranium compound is added and the aluminum–uranium alloy obtained is separated from the halides. Chloride and bromide are added to the halide mixture at a mol/ratio of 9 to 13. (Gmelin Inst)

31543 METHOD FOR THE PRODUCTION OF THORIUM CONTAINING MAGNESIUM ALLOYS. John Nicholas Reding, Jr. (to Dow Chemical Co.). German Patent 1,165,875. Mar. 19, 1964. Priority date Feb. 25, 1959, United States.

Steps in the reaction of thorium fluoride with an excess of liquid magnesium in the presence of lithium fluoride for advancement of the melting process are described. (Gmelin Inst)

31544 DEVICE AND METHOD FOR THE PRODUCTION OF ZIRCONIUM AND HAFNIUM. Milo Pelc Hnilicka, Jr. (to National Research Corp.). German Patent 1,166,481. Mar. 26, 1964. Filed Aug. 8, 1961.

Zirconium or hafnium is produced by reacting a solid halide, e.g., the tetrachloride of one of these metals, with a metallic reduction agent, e.g., magnesium. The device for carrying out this reaction consists of a horizontally arranged tubular furnace into which a retort is inserted. The retort is subdivided by a thermally insulating partition wall into an evaporation chamber in which an open vessel containing the halide is located, and a reduction chamber in which the reduction vessel is located. The partition wall has an opening so that the two chambers are in communication. The retort is closed by a thermally insulating door. A method for operating this device is given. (Gmelin Inst)

31545 METHOD FOR THE PREPARATION OF URANIUM OXIDE SOLS USED IN NUCLEAR REACTORS. Forrest R. Hurley, Melvin Tecotzky, and Milton C. Vanik (to W. R. Grace and Co.). German Patent 1,166,757. Apr. 2, 1964. Priority date Jan. 8, 1960, United States.

The sol prepared consists of uranium(IV) oxide particles dispersed in a watery medium. The anions were removed from a watery solution containing uranium tetrachloride. The method consists of heating the base solution to a temperature of 60 to 100°C, removing the anions from part of the solution at 15 to 35°C that was separated continually or discontinually, returning this solution to the base solution, and continuing with this treatment until the uranium oxide particles are of colloidal size. (Gmelin Inst)

Organic Chemistry

31546 (CEA-R-2386) DÉCOMPOSITION THERMIQUE DU BIPHENYLE. (Thermal Decomposition of Biphenyl). Michel Clerc (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 69p.

Thesis submitted to Université, Paris.

The rates of formation of the decomposition products of biphenyl: hydrogen, methane, ethane, ethylene, as well as triphenyls have been measured in the vapor and liquid phases of 460°C. The study of the decomposition products of biphenyl at different temperatures between 400 and 460°C has provided values of the activation energies of the reactions yielding the main products of pyrolysis in the vapor phase:

Product	Activation Energy
Hydrogen	73 ± 2 kcal/mole
Benzene	76 ± 2 kcal/mole
Metatriphenyl	53 ± 2 kcal/mole
Biphenyl decomposition	64 ± 2 kcal/mole

The rate of disappearance of biphenyl is only very approximately first order. These results show the major role played at the start of the decomposition by organic impurities which are not detectable by conventional physicochemical analysis methods and the presence of which

accelerates noticeably the decomposition rate. It was possible to eliminate these impurities by zone-melting carried out until the initial gradient of the formation curves for the products became constant. The composition of the high-molecular weight products (over 250) was deduced from the mean molecular weight and the dosage of the aromatic C−H bonds by infra-red spectrophotometry. As a result, the existence in tars of hydrogenated tetra, penta, and hexaphenyl has been demonstrated. (auth)

31547 (EUR-1635.f) PROPRIETES THERMIQUES DES POLYPHENYLES. I. APPAREILS DE MESURES DES CARACTERISTIQUES PHYSIQUES DES FLUIDES CALOPORTEURS ORGANIQUES. II. ETUDE DU COEFFICIENT D'ECHANGE ET DE L'INFLUENCE DE L'ENCRASSEMENT SUR E'ECHANGE DE CHALEUR. (Thermal Behavior of Polyphenyls. I. Instruments for Measuring the Physical Characteristics of Liquid Organic Coolants. II. Study of Heat Exchange Coefficient and Effect of Fouling on Heat Exchange Process). (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 184p.

Results are given of the studies carried out on the thermal behavior of certain polyphenyls. The specific mass, thermal conductivity, specific heat, and vapor tension of diphenyl, of various mixtures of terphenyl isomers, and of mixtures of terphenyls and pyrolytic and radiolytic decay products of various origin were determined up to 450°C, using instruments specially designed and developed for this research. The heat exchange coefficient, in forced convection without boiling, for the same substances was studied as a function of speed and temperature and empirical correlations were established. The relation $Nu = 0.00835\ Re^{0.9}\ Pr^{0.4}$ is satisfied by 95% of the experimental points with a relative deviation of less than ±6%. Tests were also carried out to study the fouling phenomenon caused by terphenyl on the heating walls. (auth)

31548 (IA-884) CHROMATOGRAPHIC SEPARATION OF AROMATIC ACIDS. M. Mantel and E. Kushnir (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Nov. 1963. 8p.

A method is described for separating benzoic, mono- and dihydroxy benzoic, o-iodobenzoic and diphenic acids, on the same paper chromatogram. All of these compounds were separated with a single solvent with the exception of diphenic acid, on which bidimensional chromatography was used. Four different methods were used for detecting the acids on the paper: spraying, ultraviolet illumination, scanning, and autoradiography. (auth)

31549 (JEN-123-DQ/I-37) COMPORTAMIENTO PIROLÍTICO DE LAS MEZCLAS TERFENÍLICAS COMERCIALES "PROGIL OM1, OM2, Y OMP." (Pyrolytic Behavior of the Commercial Terphenyl Mixtures Progil OM1, OM2, and OMP). R. Barrera Piñero and J. Manero Rodriguez (Spain. Junta de Energia Nuclear, Madrid). 1963. 72p.

Static tests on the thermal stability of the three commercial terphenyl mixtures OM1, OM2, and OMP and pure p-terphenyl at temperatures from 400 to 470°C are described. It was concluded that the kinetics of the pyrolysis was controlled by the following steps: (a) gas evolution (hydrogen and hydrocarbons), (b) formation of intermediate boiling compounds such as biphenyl, benzene, alkyl-benzenes, (c) evolution of high boiling compounds, and (d) decrease in the amount of initial material. Comparative data on the decomposition rate and activation energy of the pyrolysis are tabulated. Correlations between several physical properties and the polymer concentration were determined. These data are evaluated in order to achieve criteria for the selection of such terphenyl mixtures for moderators and coolants of reactors. (tr-auth)

31550 (NP-14122) UNIMOLECULAR DECOMPOSITION AND SOME ISOTOPE EFFECTS OF SIMPLE ALKANES AND ALKYL RADICALS. B. S. Rabinovitch and D. W. Setser (Washington. Univ., Seattle and Kansas State Univ., Manhattan). [1963]. 143p.

A study is made of the typical characteristics of unimolecular reactions and their dependence on the energy parameters of the system and on molecular structure. The theory of unimolecular reactions is reviewed, and theoretical calculations are made for various model hydrocarbon-type molecular species. Kinetic isotope effects are considered, and model calculations are done for H-D substitution as an illustrative example. The relation of the specific rate constants to the experimental parameters of various systems is described. The behavior of some C_1-C_4 alkanes (CH_4, C_2H_6, C_3H_8, $n\text{-}C_4H_{10}$) and alkyl radicals (C_2H_5, C_3H_7, C_4H_9) is calculated. (D.L.C.)

31551 PREPARATION OF ^{14}C-LABELED SUCCINOSEMIALDEHYDE. I. Witt and H. Holzer (Albert-Ludwigs-Universität, Freiburg i. B.). Acta Biol. Med. Ger., 11: 712-19(1963). (In German)

Uniformly labeled glutamic acid was converted to succinosemialdehyde by means of ninhydrin. One hundred mg glutamic acid, 110 μg uniformly labeled ^{14}C-glutamic acid (8.7×10^6 cpm) and 200 mg ninhydrin were dissolved in 20 ml 0.5N acetic acid and maintained on the steam bath 30 min. After rapid cooling, 20 ml distilled water was added. Then 600 mg Norit A was added; after five minutes the solution was filtered and the filter washed with distilled water. In the filtrate 50 to 60% of the original activity was found. The volume was reduced on a flash evaporator at 30°C to 2 to 3 ml, and this solution was fixed on a Dowex-50 column (H form, dia two cm, height 15 cm) and eluted with distilled water. The glutamic acid was adsorbed and the succinosemialdehyde was separated with 12 to 15 fractions of 5 to 8 ml each, in which the aldehyde was quantitatively contained, with the maximum in the fifth fraction. The procedure requires 30 to 45 min, and no fraction collector is required. The aldehyde-containing fractions were combined and lyophilized, and the residue taken up in distilled water. This solution contained 40 to 45% of the original activity (sp act. of the aldehyde: 5.8 mC/mol). Paper chromatography of the 2,4-DNP derivative (descending, Schleicher & Schuell 2043b, washed with 1M $NaHCO_3$ and dried at room temperature; isoamyl alcohol equilibrated with 0.1M acetate buffer to pH 5) gave R_f 0.13 to 0.15. The material was also characterized by electrophoretic properties and the fluorescence of the quinaldine it gives on reaction with 3,5-diaminobenzoic acid; the latter may be used for quantitative estimation. (BBB)

31552 THE SYNTHESIS OF C-14 TAGGED COMPOUNDS. J. Herok (Farbwerke Hoechst AG, Frankfurt am Main). Atomwirtschaft, 9: 269-72(June 1964). (In German)

An extensive synthesising process is necessary in order to produce a tagged preparation and the time required is often greater than that needed by the research worker for investigations using the material. These radioactive compounds are considerably more expensive than the corresponding inactive products since in synthesising such compounds because of special problems, complicated processes, and an unusually high expenditure of labor. In

tagging with ^{14}C compounds must be built up in an intricate way from barium carbonate and this is the case not only with complicated substances but even with those materials which are otherwise available as cheap raw materials for syntheses, e.g., benzene, toluene, phenol, acetic acid, etc. Almost always more steps are needed in the synthesis of tagged compounds than in the preparation of the inactive forms. Chemical impurities amounting to a few per cent are, in most cases, without significance in the application of the tagged compounds but this is not true of radioactive impurities, which would lead to an erroneous interpretation of the experimental results. The purification processes, chromatographic or electrophoretic methods, take a long time as do also the processes by which the purity of the compound is checked. The storage of ^{14}C tagged compounds is not simple and is only possible for a limited time. (auth)

31553 STUDIES OF TRITIUM-LABELED COMPOUNDS. VII. THE PLATINUM-CATALYZED EXPOSURE REACTION. Teruhiko Meshi and Yoshishige Sato (Tanabe Seiyaku Co., Ltd., Higashiyodogawa-ku, Osaka). Bull. Chem. Soc. Japan, 37: 683-7(May 1964).

In order to elucidate the nature of the chemisorption in the platinum-catalyzed exposure reaction with tritium, the effects of the substituents upon the hydrogen–tritium exchange of the aromatic ring and upon the tritium distribution in benzoic acid, salicyclic acid, and benzoylvaline were investigated. All the substituents except the hydroxyl group decrease the hydrogen-tritium exchange of the aromatic ring, and the compounds carrying those substituents poison the catalyst for the tritium incorporation of benzene. The tritium distribution in benzoic acid and salicylic acid suggests that the hydrogen–tritium exchange in the aromatic ring may follow the substitution rule for electrophilic aromatic exchange. The relative hydrogen–tritium exchange rates of benzoylvaline show that the more readily a hydrogen dissociates, the more rapidly it undergoes the exchange. (P.C.H.)

31554 ON THE ISOTOPIC EXCHANGE OF HYDROGEN IN 3,5-DIMETHYLISOXAZOLE WITH ACIDS. V. N. Setkina and S. D. Sokolov (Inst. of Elementary Organic Compounds, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 5, 936-7(May 1964). (In Russian)

Studies of the isotopic exchange between the hydrogen atom on the C in the 4-position in 3,5-dimethylisooxazole with acids showed that a strong sulfuric acid saturation of the medium inhibits the isooxazole nucleus tendencies for electrophilic exchange. (R.V.J.)

31555 THE MASS SPECTRA OF DIPEPTIDES. Harry J. Svec and Gregor A. Junk (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 86: 2278-82(June 5, 1964). (IS-793)

The mass spectra of twenty-two dipeptides, several deuterated dipeptides, and two cyclodipeptides are reported. The interpretation of these spectra is consistent with work published previously on amino acids, peptides, and their more volatile derivatives. The observed dipeptide spectra are shown to be the summation spectra of the dipeptide and the cyclodipeptide formed by thermal cyclization in the mass spectrometer. Each spectrum, however, is unique so that identification and sequence determination is possible. Qualitative predictions of the mass spectra of pure cyclodipeptides and the methods used to detect the presence of a cyclodipeptide are given. (auth)

31556 SECONDARY α-DEUTERIUM ISOTOPE EFFECTS IN ACETOLYSES OF ENDO- AND EXO-NORBORNYL AND 2-(Δ^3-CYCLOPENTENYL)ETHYL ARENESULFONATES. C. C. Lee and Edward W. C. Wong (Univ. of Saskatchewan, Saskatoon). J. Am. Chem. Soc., 86: 2752-3(July 5, 1964).

Secondary α-deuterium kinetic isotope effects were observed in the acetolyses of endo- and exo-norbornyl-2-d p-bromobenzenesulfonates and 2-(Δ^3-cyclopentenyl)-ethyl-1,1-d_2 p-nitrobenzenesulfonate. (M.C.G.)

31557 SYNTHESIS OF N-(3′-CHLORO-4′-METHYLPHENYL)-2-METHYLPENTANAMIDE-1-C^{14}. Sylvan E. Forman and Clifford A. Erickson (FMC Corp., Princeton, N. J.). J. Chem. Eng. Data, 9: 400-1(July 1964).

N-(3′-Chloro-4′-methylphenyl)-2-methylpentanamide-1-^{14}C, a radiotagged form of the selective herbicide solan, was prepared for use in fundamental biological studies. To achieve the synthesis, isomerically pure 2-chloropentane, which was prepared by the reaction of silver 2-methylpentanoate with chlorine, was converted to the Grignard reagent, which was reacted with carbon-14 dioxide. The resulting acid reacted with N,N′-bis-(3-chloro-4-methylphenyl)-phosphenimidous amide, which was obtained from the reaction of 3-chloro-4-methylaniline with phosphorus trichloride, and the desired compound was obtained with an overall radioyield of 62%. (auth)

31558 NEW HETEROAROMATIC BORON COMPOUNDS. XIX. WATER-SOLUBLE DERIVATIVES OF 10,9-BORAZAROPHENANTHRENE AND 2,1-BORAZARONAPHTHALENE AS POTENTIAL AGENTS FOR NEUTRON CAPTURE THERAPY. Michael J. S. Dewar, J. Hashmall, and Ved P. Kubba (Univ. of Chicago). J. Org. Chem., 29: 1755-7(July 1964).

A number of aminoalkyl derivatives of 10-methyl-10,9-borazarophenanthrene and of 2-methyl-2,1-borazaronaphthalene were prepared by N-alkylation of the parent compounds via the N-lithio derivatives for test as possible agents for the neutron capture therapy of cancer. Several other derivatives of these rings systems also are described. (auth)

31559 A CONVENIENT PREPARATION OF CHLOROFORM-d. Ronald Kluger (Columbia Univ., New York). J. Org. Chem., 29: 2045-6(July 1964).

Deuterium-labeled chloroform was prepared by first reacting sodium peroxide and deuterium oxide to obtain sodium deuterioxide, which was then reacted with chloral. The reaction utilizes all deuterium to form the sodium deuterioxide and avoids the danger of explosion since oxygen, instead of deuterium, is evolved. Deuterium oxide, used as solvent, is recoverable without significant loss of purity. (P.C.H.)

31560 PROTON MAGNETIC RESONANCE SPECTRUM OF 1,1,2,2,4,4,5,5-OCTADEUTERIOCYCLOHEXANE. Norbert Muller and Peter J. Schultz (Purdue Univ., Lafayette, Ind.). J. Phys. Chem., 68: 2026-8(July 1964).

1,1,2,2,4,4,5,5-Octadeuteriocyclohexane (ODCH), which was expected to yield a proton resonance spectrum much simpler than that of ordinary cyclohexane, was prepared. The spectrum recorded at −95°C is in qualitative agreement with the prediction that there should be a small but perceptible broadening for the pair of signals from the equatorial hydrogens and a considerably more pronounced broadening for the axial hydrogen signals, but all the signals are somewhat broader than expected. Reducing the temperature to −110°C resulted in no appreciable sharpening of the signals. Thus, it appears that the observed line widths are not due to incomplete freezing-out of the conformational inversion. (P.C.H.)

31561 RADIOLUMINESCENCE OF ORGANIC SUBSTANCES. III. SPECIFIC QUENCHING IN EXCITATION WITH FAST ELECTRONS. S. F. Kilin, M. S. Mikhelashvili, and I. M. Rozman. Opt. i Spektroskopiya, 16: 663-73(Apr. 1964).

The results of an investigation of the luminescence of alcohol and aqueous solutions of a number of organic compounds were examined. A considerable shortening of the duration of luminescence during excitation with x rays in comparison with the duration of the photoluminescence undoubtedly attests to the presence of specific quenching of radioluminescence in these solutions. Based on the data presented it can be considered experimentally proven that in the excitation of organic scintillators with fast electrons, quenching processes can occur in addition to photoluminescence. The proposed interpretation of the phenomenon leads to the correct relationships between the durations and outputs of radio- and photoluminescence. It is important to note that similar processes of quenching are inherent not only in good scintillators. It was concluded that data that is very valuable in understanding the mechanism of interaction of hard radiation with organic substances can be obtained. (TCO)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 32853 and 32964.

31562 (A/CONF.28/P/198) CURRENT STATUS AND FUTURE PROSPECTS FOR COMMERCIAL RADIATION PROCESSING. Joseph E. Machurek (Atomic Energy Commission, Washington, D. C.), George R. Dietz, and Martin H. Stein. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Present commercial uses of radiation (e.g., production of crosslinking in polythene, fabrication of semiconductor components, sterilization of medical supplies, and production of ethyl bromide), as well as near-future uses (e.g., production of wood-plastic materials, sterilization of foods, improvement of semiconductor devices, curing of coatings, production of biodegradable detergents, and improvements in textiles and polymers), are described. The available choices of radiation source are discussed. (T.F.H.)

31563 (AD-429919) EFFECTS OF IONIZING RADIATIONS ON AQUEOUS SOLUTIONS OF FORMIC AND OXALIC ACID. Final Technical Report, November 1, 1962–November 1, 1963. Joseph J. Weiss (King's Coll., Newcastle-upon-Tyne, England). Nov. 1963. Contract DA-91-591-EUC-2750. 22p.

In neutral aqueous solutions, irradiated with ^{60}Co γ rays, two reducing species, i.e., the self-trapped electron (negative polaron) thereafter denoted by $(H_2O)^-$, and primarily formed H atoms, have been shown to be present. In irradiated 1.6×10^{-2}M aqueous solutions of N_2O a yield of $G(N_2) = 3.2$ (molecules/100 ev) was found. This yield, coming from the reaction of negative polarons with N_2O, is unaltered in the presence of solutes which do not react with $(H_2O)^-$. Simple competition kinetics have been observed for $(H_2O)^-$ reacting with N_2O and a second solute which has an affinity for electrons. From the lowering of the nitrogen yields in these two solute systems, relative reactivities of various organic and inorganic solutes can be calculated. This was found to give ratios of the rate constants, in good agreement with those obtained by radiation pulse-techniques. Reactivities of primarily formed H-atoms with various organic compounds have been determined relative to their reaction with deuteroformate. In systems containing solutes which react with H-atoms by an addition reaction, the relative reactivities of these solutes towards H-atoms were obtained from the yields of hydrogen in the presence of isopropanol as solute. Some reactions of the reducing species were also studied in aquo-organic systems in the presence of oxygen. It was shown that the reactivity of H-atoms with a given solute and with O_2 follows simple competition kinetics. In these systems the yield of negative polarons appeared to be lower ($G(H_2O^-) = 2.3$) than in the systems containing N_2O where yields of $G(H_2O^-) = 3.0$ were found. (auth)

31564 (EUR-1646.f) INTERACTIONS DES RADIATIONS ET DES ACIDES DÉSOXYRIBONUCLÉIQUES. (Interactions of Radiations and Desoxyribonucleic Acids). R. Latarjet (Institut Pasteur, Paris). 1964. 12p.

Research results are summarized from studies on the radiochemistry of pyrimidine bases in the presence and the absence of oxygen and under the effect of x or γ radiation; the action of radiations on transforming DNA of bacteria in which a comparative study of the effects of x and uv rays on a tracer in the DNA of the pneumococcus in the single and double stranded states showed that the radiosensitivity of the tracer is the same in both states; the radiobiology of lysogenic bacteria in which it was shown that in E. coli K12 the induction of the prophage by uv irradiation is brought about by a radioformed cytoplasmic determinant, which is mainly a form of unstable RNA; the effect of radioactive disintegrations in yeast with emphasis on the resistance to x rays induced in yeast by the disintegration of ^{32}P and a genetic study of the nature of radioresistance; the lethal effect of radioactive atoms incorporated in DNA using an original method by which the DNA is marked at different points on its molecule by various radioactive atoms, comparison of the disintegration yields, and study of the mechanism, and the self-decomposition of radioactive solutions, in particular tritiated thymidine; the action of the radiations on genetic recombination with emphasis on sexed conjugation in E. coli K12, and the mutagenic effects of x and uv rays; and in DNA based on discovery of the catalytic action of oligo-elements, in particular cupric and ferric ions, on peroxidation. (auth)

31565 (NYO-2546) SUMMARY REPORT ON RESEARCH ON RADIATION CHEMISTRY. Paul Harteck and Seymour Dondes (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 15, 1959. Contract AT(30-3)-52. 12p.

The decomposition of carbon dioxide into carbon monoxide and oxygen was the first reaction studied. Re-oxidation of the carbon monoxide to carbon dioxide during irradiation was found to be a more complex process than generally assumed. The reaction mechanism involved carbon atoms and carbon suboxides. Furthermore, it was shown that the back reaction to reform carbon dioxide during irradiation could be inhibited by the addition of nitrogen dioxide. Subsequently, the decomposition of nitrous oxide, nitric oxide, and nitrogen dioxide and the formation of nitrogen oxides from nitrogen–oxygen mixtures were studied. These studies provided the basis for (1) design of a nitrous oxide dosimeter and (2) development of a process for the fixation of nitrogen by ionizing radiation. Sources of ionizing radiation used in various phases of the research included (1) alpha particles from radon, (2) beta particles from strontium-90, (3) pile radiation, and (4) fission fragments. Small-diameter glass or mineral fibers containing enriched uranium

were found to provide a satisfactory source of fission fragments for irradiation of a gas or liquid. (auth)

31566 (TID-18567(p.2-6)) CARRIER-FREE CHEMICAL PROCEDURES. (Ohio State Univ. Research Foundation, Columbus).

Procedures were developed to secure "weightless" samples (10^{-7} grams or less), free of active contaminants, for studies of beta spectra. Methods are reviewed for separation of: cobalt from activated iron; cobalt, zinc, barium, and cesium from their dilute solutions; rhodium from activated ruthenium; rhenium from activated tantalum or tungsten; and bromine from activated selenium and arsenic. (R.E.U.)

31567 (TID-18567(App. V)) CARRIER-FREE CHEMICAL SEPARATION OF RHENIUM FROM TANTALUM OR TUNGSTEN TARGETS. John R. Comerford and M. H. Kurbatov (Ohio State Univ. Research Foundation, Columbus). 5p.

Anion exchange separation was investigated for obtaining very pure samples of rhenium from either tungsten or tantalum targets. The samples were carrier-free as well as salt free, and were obtained in about one hour. Impurity assaying procedures for ^{65}Zn, ^{86}Rb, and ^{64}Cu are discussed. (R.E.U.)

31568 (TID-18567(App.VI)) CARRIER-FREE CHEMICAL SEPARATION OF BROMINE FROM SELENIUM OR ARSENIC CYCLOTRON TARGETS. John R. Comerford and M. H. Kurbatov (Ohio State Univ. Research Foundation, Columbus). 7p.

Anion exchange separation of bromine from selenium or arsenic using Dowex 1, X-8, 100-200 mesh resin is reported. Pure samples (carrier-free and salt-free) were obtained in four to five hours after receipt of irradiated cyclotron targets. Impurity assaying of ^{24}Na, ^{64}Cu, ^{65}Zn, and ^{86}Rb is discussed. (R.E.U.)

31569 (TID-20812) TEMPERATURE DEPENDENCE OF THE RADIATION POLYMERIZATION OF MONOMER SOLUTIONS (thesis). Leo Wade, Jr. (Kansas. Univ., Lawrence. Graduate School). May 1964. 44p.

Experiments were conducted to determine the temperature dependence of the radiation polymerization dosimeter employing triethylene glycol dimethacrylate (TEDMA) with various inhibitors to control the gel dose. All monomer solutions exhibited a sensitivity to thermal initiation, but triphenylstibine (TPS) seemed to partially overcome this effect. The results indicated that diphenylpicrylhydrazyl (DPPH) is an inhibitor, whereas TPS, oxygen, and p-benzoquinone are retarders. Activation energies were calculated for thermal polymerization, radiation polymerization, and for the thermal initiation reaction. The overall activation energy for radiation polymerization was found to be 3.1 kcal/mole. Calculations yielded a value for the overall activation energy for thermal polymerization of 15.1 kcal/mole. The activation energy for thermal initiation was calculated to be 20.1 and 24 kcal/mole. (N.W.R.)

31570 (UCRL-11359) PROPOSED MOLECULAR BEAM DETERMINATION OF ENERGY PARTITION IN THE PHOTODISSOCIATION OF POLYATOMIC MOLECULES. Richard N. Zare and Dudley R. Herschbach (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 29, 1964. Contract W-7405-eng-48. 53p.

Conventional photochemical experiments give no information about the partitioning of energy between translational recoil and internal excitation of the fragment molecules formed in photodissociation of a polyatomic molecule. In a molecular beam experiment, it becomes possible to determine the energy partition from the form of the laboratory angular distribution of one of the photodissociation products. A general kinematic analysis is worked out in detail, and the uncertainty introduced by the finite angular resolution of the apparatus and the velocity spread in the parent beam is examined. The experimental requirements are evaluated for the photolysis of methyl iodide by the 2537 Å Hg line. (auth)

31571 (UVJ-1005/64) EFFECTS OF IONIZING RADIATION ON EXTRACTANS-KETONES. PART III. RADIATION-CHEMICAL FORMATION OF URANIUM PEROXIDE IN KETONIC URANYL NITRATE SOLUTIONS. J. Teplý, V. Štulík, M. Teichmanová, and J. Moravec (Československa Akademie Ved. Ustav Jaderneho Vyzkumu, Rez). [1964]. 28p.

During the irradiation with γ-^{60}Co of uranyl nitrate solutions in methylisobutylketone and methylcyclohexanone saturated with water and oxygen, an insoluble precipitate is produced. It was identified as a uranium peroxide with the probable formula $UO_4 \cdot 4H_2O$. Its radiation yields decrease by increasing the concentration of uranyl nitrate above 0.1 M in methylisobutylketone and 0.02 M in methylcyclohexanone. It decreases also by increasing the concentration of nitric acid and increases by increasing the concentrations of water and oxygen. This uranium peroxide originates also by a direct precipitation with diluted hydrogen peroxide from a ketonic medium. In the two-phase ketone–water system containing dissolved uranyl nitrate, the precipitate is formed preferentially in the interface layer. In the water solution, it is produced to an unimportant extent at the concentrations less than 0.005 M $UO_2(NO_3)_2$. (auth)

31572 PURINE N-OXIDES. XII. PHOTOCHEMICAL CHANGES INDUCED BY ULTRAVIOLET RADIATION. George Bosworth Brown, Gershon Levin, and Sarah Murphy (Cornell Univ., New York). Biochemistry, 3: 880-3(July 1964). (TID-20531)

Adenine 1-N-oxide is found to be very sensitive to uv radiation. For it, and related purine derivatives, two main pathways of decomposition are observed: direct loss of O, and rearrangement of the O to the adjacent C. (auth)

31573 PURINE N-OXIDES. XIII. KINETICS OF THE PHOTOCHEMICAL ALTERATION OF ADENINE 1-N-OXIDE. Gershon Levin, Richard B. Setlow, and George Bosworth Brown (Cornell Univ., New York and Oak Ridge National Lab., Tenn.). Biochemistry, 3: 883-4(July 1964). (TID-20538)

Adenine 1-N-oxide is decomposed by uv light with a quantum efficiency of 0.10 and with an action spectrum paralleling the uv-absorption spectrum. The unique absorption spectrum of adenine 1-N-oxide and its relation to the spectra of the products permits it to be proposed as a practical and simple dosimeter for irradiations with the biologically important wavelengths near 260 mμ. (auth)

31574 ELECTRICAL CONDUCTIVITY IN ALKALI HALIDES INDUCED BY ELECTRON BOMBARDMENT. P. R. Collings and J. Hirsch (London Univ.). Brit. J. Appl. Phys., 15: 797-800(July 1964).

Electron-bombardment induced conductivity was observed in microcrystalline layers of several alkali halides using special precautions to minimize polarization. The current gains varied from the low value of unity for LiF to one comparable with As_2S_3 for RbBr. There seemed to be no primary voltage threshold for the effect. Saturation of the gain was observed in some cases. (auth)

31575 KINETIC ENERGIES OF FRAGMENT IONS FROM n-BUTANE RESULTING FROM ELECTRON IMPACT. Miyako Inoue and Akibumi Danno (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 879-85(June 1964).

The discrimination effect on the fragment ions from n-butane produced by electron impact was investigated using a conventional mass spectrometer. From the effect of discrimination, it was concluded that the relative intensity of fragment ions with initial energies larger than their thermal energy is markedly dependent on the conditions of measurement. On the basis of the results, the amount of the kinetic energy for fragment ions from n-butane was estimated. It is reasonable to consider that considerable portions of $C_3H_7^+$, $C_3H_6^+$, $C_2H_4^+$, and $C_2H_3^+$ ions are produced with high kinetic energies from the dissociation of the doubly-charged molecule-ion, according as the high kinetic energy of the CH_3^+ ion is produced. (P.C.H.)

31576 GAMMA MEASUREMENTS. CHEMICAL DOSIMETRY. J. Jaspert (Centre d'Etudes Nucleaires, Grenoble, France) and J. R. Puig. Bull. Inform. Sci. Tech. (Paris), No. 82, 31-7(Apr. 1964). (In French)

The in-pile dosimetry of gamma radiations using chemical methods was surveyed. The measurement of gamma rays involves the separation of the fast neutron constituent of the absorbed dose since the chemical systems proposed are aqueous solutions or hydrocarbons. Liquid cyclohexane and aqueous solutions of ceric sulfate were used for this purpose. Aqueous solution of oxalic acid, and also of deaerated solutions of ferrous sulfate may be used as well as gaseous nitrous oxide. However all the systems have serious disadvantages and more research is necessary to produce a satisfactory chemical dosimeter for in-pile use. (auth)

31577 EFFECTS OF IONIZING RADIATIONS ON TRIBUTYL PHOSPHATE (TBP). Jennifer Canva and Monique Pages (Universite, Paris). Bull. Soc. Chim. France, No. 5, 909-11(May 1964). (In French)

Some results obtained by a new method for the determination of the principal nongaseous radiolytic products (di- and monobutylphosphoric acids) are reported to present new data on the possible mechanism for the radiolytic degradation. The acids are determined by potentiometry in gaseous medium. The results show that the yield of the acids increases as a function of the irradiation duration and the initial concentration of iodine. This increase is not incompatible with the hypothesis of an ionic mechanism for TBP degradation. The effect of organic additives on the rate of degradation was determined for benzene, toluene, naphthalene, diphenyl, dodecane, phenanthrene, hexane, or cyclohexane. The nonaromatic compounds sensitized the radiolysis of TBP. Hypotheses to interpret these results are given. (J.S.R.)

31578 THE RADIATION CHEMISTRY OF SQUALENE. Jeanne Danon and Morton A. Golub (Stanford Research Inst., Menlo Park, Calif.). Can. J. Chem., 42: 1577-94 (July 1964).

Squalene was irradiated with ^{60}Co γ rays at room temperature and with 1-Mev electrons at −30°C. The main radioinduced effects and their G-values for the room temperature irradiations were loss of unsaturation (4.6), crosslinking (1.35), trans → cis isomerization (0.83), and evolution of hydrogen (0.58). The G-values for the first three processes in the low temperature runs were 3.8, 0.82, and 0.83, respectively. The large drop in unsaturation is attributed in part to the formation of crosslinks involving double bonds, but principally to cyclization. The loss of double bonds occurs only in the immediate vicinity of the crosslinks and not at random throughout the irradiated squalene. This result has important implications for the radiolysis of diene polymers. Squalene in 10% benzene solution isomerizes with a much higher yield (apparent G-value of 2.6 trans double bonds converted initially per 100 ev absorbed by both solute and solvent) than that of the pure olefin, indicating very efficient energy transfer from excited benzene molecules to the squalene double bonds. The isomerization in the solution case was accompanied by a loss of double bonds in squalene (G-value of 0.98) due to phenylation as well as to the other indicated saturation reactions. (auth)

31579 SYNTHESIS OF TRYPTOPHAN–CARBOXYL–^{14}C. G. P. Slater (National Research Council of Canada, Saskatoon, Saskatchewan). Can. J. Chem., 42: 1768-70 (July 1964).

Tryptophan labeled in the carboxyl group with ^{14}C was synthesized from indole-3-aldehyde and hydantoin-4-^{14}C using a modification of the procedure previously described for the corresponding ^{13}C-labeled compound. Indolylidenehydantoin was reduced by the action of Raney nickel alloy in dilute sodium hydroxide solution, instead of using Raney nickel catalyst in sodium hydroxide. The reduction product, indolymethylhydantoin, was not isolated, but its aqueous solution was hydrolyzed with barium hydroxide and the tryptophan isolated by ion-exchange chromatography. (P.C.H.)

31580 THE SZILARD-CHALMERS EFFECT ON XENON TETRAFLUORIDE. Francis Schroth and Jean-Pierre Adloff (Centre de Recherches Nucléaires, Strasbourg). Compt. Rend., 258: 5863-5(June 15, 1964). (In French)

The retention of the radioactive isotopes of xenon in xenon tetrafluoride irradiated in the solid state by neutrons is, on an average, 60%. During the acid or alkaline hydrolysis of the irradiated product, ^{125}I formed by electron capture of ^{125}Xe appears entirely in the periodate form. A basic form of Xe(VI) was shown by paper electrophoresis. (tr-auth)

31581 A GENERAL DISCUSSION ON FUNDAMENTAL PROCESSES IN RADIATION CHEMISTRY, 2ND–4TH SEPTEMBER, 1963. Discussions Faraday Soc., No. 36: 1-325(1963). (CONF-224)

Twenty-three articles are included: separate abstracts were prepared for two. The remaining 21 articles were previously abstracted in NSA as numbers: 17: 27406, 39097, 39098, 39099, 39100, 39107, 39148, 39149, 39150, 39151, 39152, 39153, 39154, 39156, 39157, 39158, 39159, 39160, 39161, and 39162; and 18: 25555. (P.C.H.)

For abstracts of individual papers see: 31582 and 31583.

31582 FUNDAMENTAL PROCESSES IN RADIATION CHEMISTRY: EFFECTS OF THE STATE OF AGGREGATION. Milton Burton (Univ. of Notre Dame, Ind.). Discussions Faraday Soc., No. 36, 7-18(1963).

The variety of processes are discussed in a detailed way and comments are made on various models and mechanisms. For elucidation of the ensuant discussion, certain usages are examined and defined. The papers of the Conference are briefly reviewed and the conclusion is reached that state of aggregation is now shown to affect fundamental processes in clearly discernible fashion. (auth)

31583 GENERAL DISCUSSION [ON RADIATION CHEMISTRY]. Discussions Faraday Soc., No. 36, 232-325 (1963).

Comments and discussion are given on the various papers presented at the conference. (P.C.H.)

31584 CHANGE IN ELECTRICAL CONDUCTIVITY OF KCl CRYSTALS ON ADDITION OF BIVALENT IMPURITIES AFTER X-RAY IRRADIATION. I. Ya. Melik-Gaykazyan, E. K. Zavadovskaya, and M. I. Ignat'eva. Fiz. Tverd. Tela, 6: 1243-6(1964).

Ionic conductivity and its radiation change during equal doses of x irradiation (~4×10^4 roentgens) in KCl · Pb and KCl · Sr crystals, and the density of F centers in KCl · Sr were studied. Pb and Sr impurities had altogether different acceptor properties relative to holes. Pb^{2+} in NaCl was an acceptor of electrons, but Sr^{2+} in KCl gave rise to activator hole centers. In KCl a comparatively small increase in electrical conductivity accompanying the injection of Sr up to 2×10^{-2} mol % corresponded to an increase in F centers of 210%. The maximum increase in density of F centers in KCl activated by Pb did not exceed 70%. Changes in conductivity with changes in impurity concentration indicated that the first are observed only in the interval of concentration for which a change in conductivity in nonirradiated crystals takes place. Conductivity in a crystal was found to affect radiation change only at those impurities situated in regular points of the crystal lattice. Increased radiation changes in the conductivity of KCl · Pb were observed, first, through decrease in number of current carriers arising during localization of holes at single ion vacancies and, second, because of increased stability of hole centers that formed through the appearance of electron atomic centers. (A.I.D. Press)

31585 OXIDATION OF PLUTONIUM(III) IN HYDROCHLORIC ACID SOLUTIONS BY GAMMA RAYS. A. S. Ghosh Mazumdar, R. N. Singh, and B. Srinivasan (Atomic Energy Establishment, Trombay, India). Indian J. Chem., 2: 226-29(June 1964).

The effects of gamma rays on the plutonium(IV)/plutonium(III) system in HCl solutions of varying concentration (1.0 to 8.0M) were studied both in the presence of air and in an inert atmosphere of argon. The plutonium concentration in solution was varied from 0.001 to 0.01M. Plutonium(III) was oxidized completely to plutonium(IV) when irradiated by the gamma rays available in the pool of the "Apsara" reactor, outside its core, provided sufficient dose is allowed to be absorbed. The observed yields of oxidation products were independent of initial plutonium(III) concentration. In the absence of air, G[Pu(IV)] was equal to 0.35 × molarity of HCl, whereas in the presence of air the G[Pu(IV)] value varied with the dose absorbed, and the initial value was four times that obtained in the absence of air. The results seemed to show that the oxidation proceeds mainly through the species formed by direct action of radiation on HCl. (auth)

31586 INSECTICIDE LABELING: A SIMPLE TECHNIQUE FOR TRITIATION OF AROMATIC INSECTICIDES. B. D. Hilton and R. D. O'Brien (Cornell Univ., Ithaca, N. Y.). J. Agr. Food Chem., 12: 236-8(May-June 1964).

The tritiating technique of Yavorsky and Gorin (J. Am. Chem. Soc., 34: 1071(1962)) was used to label aromatic insecticides, and the degree of labeling, which varies greatly with compounds, examined. The method is simple, and requires little space and no expensive reagents or apparatus. The cost per labeled compound is low, and activities up to 15.5 mC/mmole are obtained. Simple aromatic hydrocarbons were tritiated by direct contact with the tritiating reagent, $H_2TPO_4 \cdot BF_3$. Exchange was effected primarily at aromatic sites, although some exchange also took place very slowly at tertiary carbons. The tritiation of two chlorinated hydrocarbons and several carbamates and phosphates is described and some general rules formulated by which the degree of labeling for different compounds can be predicted. Yields were lowest for phosphates (0 to 40%) and best for chlorinated hydrocarbons (60 to 79%), with carbamates in between (50 to 75%). The physical conditions of the reaction markedly influenced yields. Three aspects of molecular structure were of importance in controlling specific activity, which was increased by substituents that promote electrophilic substitutions. The activating effects of substituents were considered. M-directing substituents (such as nitro or quaternary nitrogen) and halogens were ring-deactivating and therefore tended to decrease labeling, whereas o,p-directing substituents other than halogens (e.g., amino or alkoxy) were ring-activating and tended to increase labeling. The directional influence had to be such that it directed toward a site available for substitution. Compounds with a large number of sites available for tritiation were more labeled. (BBB)

31587 NEUTRON THERMALIZATION THEORY APPLIED TO HOT ATOM CHEMICAL REACTIONS: CONSIDERATION OF ISOTROPIC AND ASYMMETRIC SCATTERING. Chi-hua Hsiung and Adon A. Gordus (Univ. of Michigan, Ann Arbor). J. Am. Chem. Soc., 86: 2782-9 (July 20, 1964).

The application of the neutron thermalization theory to hot-atom chemical reactions is discussed with emphasis on the possible errors involved. The assumption of isotropic scattering symmetry was specifically considered, and methods previously proposed for the handling hot-atom data were evaluated. It was concluded that, at present, the use of hot-atom data in calculating absolute values of the average energy losses and reaction probability integrals is severely limited if not impossible owing to the lack of scattering-cross-section data in the range 1 to 30 ev. However, since fewer assumptions are required, it may be possible to obtain some qualitative information about the ratios of these variables from inert gas moderated data and from systems of low total reactivity. (auth)

31588 MERCURY-PHOTOSENSITIZED REACTIONS BETWEEN PARAFFINS AND TRITIUM. A SIMPLE, RAPID, AND SELECTIVE TRITIATION TECHNIQUE. Preston L. Gant and Kang Yang (Continental Oil Co., Ponca City, Okla.). J. Am. Chem. Soc., 86: 2954-6 (July 20, 1964).

Hydrocarbon gases together with tritium were introduced in a Vycor cell, which contained a drop of mercury at room temperature. After 1 min of ultraviolet irradiation the tritiated products were analyzed. Products from self-radiolysis were also analyzed for comparison. The ultraviolet irradiation accelerated tritiation 4×10^4 to 2×10^6 times. (M.C.G.)

31589 ON ESTABLISHING MECHANISMS OF RADIATION-INDUCED NETWORK FORMATION IN HIGH POLYMERS. J. G. Spiro and C. A. Winkler (McGill Univ., Montreal). J. Appl. Polymer Sci., 8: 1709-17(July 1964).

In an effort to develop new techniques for studying the effects of irradiation on high polymers, the influence of molecular weight distribution was investigated. From general mathematical expressions, equations were developed to be used for polymers of Schulz-Zimm distributions, and their mixtures. According to the computations, it should be possible to distinguish between crosslinking and endlinking as alternative mechanisms of network formation, by comparing gelling doses for samples of

different initial distributions. From gelling dose determinations for polystyrene samples of different polydispersities, it was confirmed that network formation in irradiated polystyrene takes place through crosslinking, in agreement with mechanisms suggested by others. It is believed that the simple technique described should be useful for studying radiation processes in polymers that form networks, especially since the method is insensitive to the extent of degradation. (auth)

31590 EFFECTS OF COMPOSITION AND IRRADIATION ON THE GLASS TRANSITION TEMPERATURE OF METHYL METHACRYLATE-STYRENE COPOLYMERS. M. S. Parker, V. J. Krasnansky, and B. G. Achhammer (National Bureau of Standards, Washington, D. C.). J. Appl. Polymer Sci., 8: 1825-38(July 1964).

The glass transition temperatures of polystyrene, poly(methyl methacrylate), and copolymers prepared from their respective monomers were determined by using a volume dilatometer. The glass transition temperatures of polystyrene and poly(methyl methacrylate) were found to be 82 and 104°C, respectively. The glass transition temperatures obtained for the copolymers were between the values determined for each of the homopolymers and were a monotonic function of the polymer composition. The experimental values agree with predictions in the literature based on interpolation formulas. The effects of changes in composition and radioinduced crosslinking on the glass transition of the copolymer system are described. (auth)

31591 MEMORY EFFECTS IN IRRADIATED POLYETHYLENE. George Odian and Bruce S. Bernstein (Radiation Applications, Inc., Long Island City, N. Y.). J. Appl. Polymer Sci., 8: 1853-67(July 1964).

The memory of irradiated polyethylene was studied with emphasis on the magnitude of the restoration force exerted by the deformed polymer during the process of restoration to the nonstressed state and on the degree of completeness with which restoration occurs. The particular form of the memory effect studied involved the deformation of the heated polymer followed by locking-in of the memory via cooling. Subsequent heating restores the deformed specimen to the undeformed state. The memory effect was studied under both nontransparency (NT) and transparency (T) deformation conditions. The effects of parameters such as the polymer properties (T_m, density, molecular weight), radiation dose, and deformation and restoration conditions on the degree of restoration and restoration force were investigated. It was found that restoration temperatures equal to or above the crystalline melting point (T_m) of the polymer are required in order to obtain complete restoration. The restoration temperature increases with increasing polymer crystalline melting point. The degree of restoration increases with increasing restoration temperature for NT deformed specimens. T deformed specimens do not begin to restore until the temperature approaches the T_m of the polymer. The restoring force increases with decreasing deformation temperature. NT deformation results in larger restoring forces and faster restoration relative to T deformation. The restoring force increases with increasing radiation dose for both T and NT deformations, the effect being greater for NT deformation. Radiation dose, however, above a minimum value does not affect the degree of restoration. The restoring force increases with increasing polymer initial molecular weight for T deformation. (auth)

31592 PULSE RADIOLYSIS STUDIES. IV. THE SOLVATED ELECTRON IN THE ALIPHATIC ALCOHOLS. Irwin A. Taub, Douglas A. Harter, Myran C. Sauer, Jr., and Leon M. Dorfman (Argonne National Lab., Ill.). J. Chem. Phys., 41: 979-85(Aug. 15, 1964).

Some of the physical and chemical properties of the solvated electron in the aliphatic alcohols were investigated by means of the pulse radiolysis technique. In ethanol the optical absorption spectrum exhibits a maximum at 700 mμ. The decadic molar extinction coefficient at 5461 Å was determined to be $\epsilon_{e^-sol}^{5461} = (1.1 \pm 0.4) \times 10^4\ M^{-1}\ cm^{-1}$. From this the oscillator strength of the band from 270 mμ to about 980 mμ was estimated to be f = 0.7. The radiation chemical yield of the solvated electron in ethanol was found to be 1.0 ± 0.3 per 100 ev of absorbed energy. Absolute rate constants for a number of reactions of the solvated electron in ethanol and methanol were determined. The diphenylide ion, formed by electron attachment to diphenyl in ethanol, shows a fast first-order decay for which the rate constant was determined. (auth)

31593 EXCITON IMPURITY LEVEL AND ITS IMPLICATIONS TO RADIATION CHEMISTRY. Kanji Katsuura (Northwestern Univ., Evanston, Ill.) and Mitio Inokuti. J. Chem. Phys., 41: 989-93(Aug. 15, 1964).

Dipole matrix elements corresponding to transitions to exciton states and other associated quantities were calculated for a simple one-dimensional model of a molecular crystal containing an impurity. Emphasis was placed on transitions to certain exciton levels, characteristic of the presence of an impurity. Absorption of radiation energy by molecular aggregates containing an impurity is discussed in view of the results of the calculation. (auth)

31594 RING INVERSION IN CYCLOHEXYL RADICAL. Seiji Ogawa and Richard W. Fessenden (Mellon Inst., Pittsburgh). J. Chem. Phys., 41: 994-8(Aug. 15, 1964). (RRL-132)

The ESR spectrum of cyclohexyl radical in solid cyclohexane was studied, during irradiation, between −85 and 0°C. Continuous electron irradiation is necessary because diffusion and recombination of the radicals occurs in this temperature interval. The broadening of certain of the lines as the temperature is raised was interpreted in terms of an interconversion between two forms of the radical. The change of linewidth (or alternately, peak height) with temperature corresponds to an activation energy for the interconversion of 4.9 ± 0.5 kcal/mole. The magnitude of the barrier, though smaller than that in cyclohexane itself, suggests that the interconversion is between the two chair forms of the radical. In the calculation of correlation times from the broadening, it was necessary to develop expressions that are applicable to spectra with Gaussian lines. This treatment is verified by the agreement of the data for $C_6H_{11}\cdot$ and $C_6D_{11}\cdot$. (auth)

31595 EFFECT OF COBALT-60 γ RADIATION ON DIOXANE-1,4. Yvan Llabador and Jean-Pierre Adloff (Centre de Recherches Nucleaires, Strasbourg). J. Chim. Phys., 61: 681-5(May 1964). (In French)

The radiolytic decomposition products of dioxane were analyzed by chromatography in the gaseous phase. Dioxane is more stable to radiation than the aliphatic ethers; this radioresistance is attributable to the symmetric structure of the heterocycle. (tr-auth)

31596 EFFECT OF Co^{60} γ RAYS ON NEUTRAL OR ALKALINE SOLUTIONS OF POTASSIUM IODIDE IN THE PRESENCE OF AIR. José Jove and Jacques Pucheault (Institut du Radium, Paris). J. Chim. Phys., 61: 711-16 (May 1964). (In French)

Alkaline or neutral aerated solutions of potassium iodide were irradiated with Co^{60} γ rays. Initially, hydrogen per-

oxide is formed, which oxidizes the I^- ions only slowly, in prolonged effect. The study of $G_i(H_2O_2)$ as a function of the I^- concentration shows chiefly that this solution is, in neutral solution, a better captor of H_2O_2 precursors than Cl^-, Br^-, and NO_3^-. In alkaline medium (pH = 12.8), the capture is less efficient and the oxidation of I^- is slower by O^- than by the OH radicals. In other respects, the interpretation of these phenomena permit the proposal of a relation between the values of some molecular and radical yields relative to the two media. After a time of induction, which permits the preliminary accumulation of a certain quantity of hydrogen peroxide, the iodides are, in neutral medium, oxidized into I_2 by γ rays, hydrogen peroxide, and I_2, resulting finally in stationary states for very high doses. It is shown that this oxidation comes essentially from the action of H_2O_2 on the radical-ions I_2^-. The interpretation makes appeal to chain reaction mechanisms that can be used to explain the catalysis by the $I_2/1^-$ system of the thermal decomposition of H_2O_2. (tr-auth)

31597 RADIATION-INDUCED POLYMERIZATION AT LOW TEMPERATURE. Yoneho Tabata, Keiichi Oshima, et al. (Tokyo Univ.). J. Fac. Eng. Univ. Tokyo, Ser. A, No. 1, 46-7(Dec. 1963). (In Japanese)

Radiation-induced solid-state polymerizations of acrylonitrile, methacrylonitrile, isoprene, butadiene, acetylene, and isocyanate are reported. It was found that a stereospecific polymerization is possible in the solid-state polymerization at low temperatures. Syndiotactic polymers were obtained in the solid-state polymerization of acrylonitrile and methacrylonitrile. In the polymerization of isocyanates and acetylene, the structure of polymer polymerized in the solid state was quite different from that polymerized in the liquid state of the monomer. The polymerization mechanism is discussed with respect to the spectrophotometric measurement of the solid monomer and the analysis of the glow curves of the monomer irradiated at −196°C. A new electronic polymerization mechanism is proposed for the radiation-induced solid-state polymerization at extreme low temperature. (auth)

31598 CHEMICAL STATE OF ^{35}S FORMED BY THE $^{35}Cl(n,p)$ REACTION. C. Chiotan, I. Zamfir, and M. Szabo (Inst. for Atomic Physics, Bucharest). J. Inorg. Nucl. Chem., 26: 1332-4(July 1964).

Experiments showed that on heating KCl after irradiation at 920°C (above the melting point of KCl) as well as at 500°C (above the boiling point of sulfur) the ^{35}S atoms receive sufficient kinetic energy to migrate, from the point where they were formed, to the surface of the KCl crystals, where they can be extracted, with elementary sulfur as carrier, or directly by dissolving in trichloroethylene. The results showed that the ^{35}S produced from ^{35}Cl by the (n,p) reaction, is present in the elementary form in the KCl. (P.C.H.)

31599 DETERMINATION OF THE THERMAL DIFFUSION COEFFICIENT FOR LIQUID AMMONIA USING PULSED NEUTRON TECHNIQUES. M. P. Charles (North Carolina State Coll., Raleigh). J. Nucl. Energy, Pts. A & B, 18: 305-10(June 1964).

Measurement of the thermal neutron diffusion coefficient, D_0, and diffusion cooling coefficient, C, for liquid ammonia at its boiling point was made using the 1 Mev Van de Graaff accelerator. The value for D_0, 21,763 ± 1809 $cm^2\ sec^{-1}$, agrees well with the theoretical prediction of 23,095 $cm^2\ sec^{-1}$ using a bound-atom model and with the theoretical prediction of 25,521 $cm^2\ sec^{-1}$ using a free-atom model. The value for C is 6791 ± 2033 $cm^4\ sec^{-1}$, and for λ_0 it is 15,367 ± 297 sec^{-1} which is near the theoretical value of 15,207 ± 450 sec^{-1}. (auth)

31600 THE EFFECT OF TRANSITION METAL IONS ON THE YIELD OF "RESIDUAL HYDROGEN" IN NEUTRAL RADIOLYSIS SOLUTIONS. M. Anbar and D. Meyerstein (Soreq Research Establishment, Rehovoth, Israel). J. Phys. Chem., 68: 1713-16(July 1964).

2-d-2-Propanol was irradiated in dilute neutral aqueous solutions in the presence of acetone and the yield of HD determined. HD is formed by abstraction of the α-hydrogen of 2-propanol by the residual hydrogen. In acetone-free acid solutions HD is formed by abstraction of the α-hydrogen of 2-propanol by hydrogen atoms. Ca^{2+} and Ba^{2+} ions have no effect on the yield of HD in either unbuffered or acidified solutions. On the other hand, in unbuffered solutions, certain transition metal ions diminish the yield of HD in the following order: Ni^{2+}, Cd^{2+}, Co^{2+}, Zn^{2+}. The same ions were examined in acid solution, where hydrogen atoms are present, and were found to have no effect on the yield of HD. In other words, these metal ions, which were found not to react with hydrogen atoms, do react with the residual hydrogen or with its precursor. It is suggested that the residual hydrogen or its precursor is actually an excited water molecular, H_2O^*, which reacts with these metal ions as a reductant in analogy to their reaction with hydrated electrons. (auth)

31601 ACTION OF γ-RAYS ON AQUEOUS SOLUTIONS OF NITROUS OXIDE AND THE EFFECTS OF ADDED SOLUTES. G. Scholes and M. Simic (Durham Univ., Eng.). J. Phys. Chem., 68: 1731-7(July 1964).

Aqueous solutions of nitrous oxide (1.6×10^{-2} M) were irradiated with ^{60}Co γ rays and the yields of nitrogen and oxygen found to be $G(N_2) = 3.20 \pm 0.1$ and $G(O_2) = 1.68 \pm 0.05$. Stationary concentrations of hydrogen peroxide and of hydrogen were observed. Aspects of the mechanism of the radiolysis of N_2O solutions are discussed. The effects of the addition of various solutes, organic and inorganic, to N_2O solutions were studied. The results can be interpreted on the basis of the formation of two reducing species in the radiolysis of water, viz, the electron and a species reacting as a hydrogen atom. The reaction of these species with various solutes is discussed; in particular, it is shown that the N_2O system can be used to compare the electron reactivities of different substances. (auth)

31602 REACTIVITY OF THE HYDROGEN ATOMS PRODUCED IN THE RADIOLYSIS OF AQUEOUS SYSTEMS. G. Scholes and M. Simic (Durham Univ., Eng.). J. Phys. Chem., 68: 1738-43(July 1964).

Neutral aqueous solutions of DCOONa containing N_2O and one of several organic solutes that can be dehydrogenated were irradiated with ^{60}Co γ rays. The yields of H_2 and of HD were measured and used to obtain the relative reactivities of the solutes toward the primarily formed dehydrogenating species (hydrogen atoms). The relative reactivities of solutes, organic and inorganic, which are not dehydrogenated by hydrogen atoms, were studied using the system of 2-propanol and N_2O. (auth)

31603 RADIATION CHEMISTRY OF ARSENITE SOLUTIONS. III. EFFECT OF ARSENITE CONCENTRATION IN OXYGEN-SATURATED SOLUTION. Malcolm Daniels (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem., 68: 1866-9(July 1964).

Rates of formation of arsenate (at pH 1.3 and 10.2) and hydrogen peroxide (at pH 1.3), following ^{60}Co radiolysis of oxygen-saturated solutions of arsenite, were determined at concentrations of arsenite from 1×10^{-5} to 0.2 M. In

acid solution radical scavenging appears to be complete at 1 mM arsenite and in alkaline solutions at 0.5 mM. In both cases G values show a steady increase at higher concentrations, the relationships being $G(As(V)) = 2.6 + 26.0(As(III))_0$ at pH 1.3 and $G(As(V)) = 7.5 + 51.0(As(III))_0^{\frac{1}{2}}$ at pH 10.2. It is suggested that these effects are due to a chain reaction and a unified mechanism is presented fitting both sets of data. (auth)

31604 THE RADIATION CHEMISTRY OF POLYETHYLENE. VII. POLYENE FORMATION. M. B. Fallgatter and Malcolm Dole (Northwestern Univ., Evanston, Ill.). J. Phys. Chem., 68: 1988-97(July 1964).

Linear polyethylene irradiated with ^{60}Co γ rays up to doses of 300 Mrads exhibits a number of ultraviolet absorption bands characteristic of polyenes of the structure $CH_3(CH = CH)_nCH_3$ where n has values from 2 to 5. Other ultraviolet peaks might be due to polyenyl free radicals, but these assignments have yet to be confirmed. It is demonstrated that diene production occurs at a much greater rate than expected statistically and that it is not proportional to vinylene concentration. Diene is formed at a considerably reduced rate in low density polyethylene, in linear polyethylene swollen with benzene, and apparently not at all in the liquid state. Vinylene growth is approximately the same under all these conditions. Consideration of diene formation brings about material balance for room temperature irradiation of linear Marlex-50 polyethylene but not for irradiations in the liquid state. A suggested mechanism is given. (auth)

31605 A COMPLICATING FACTOR IN THE PHOTOCHEMICAL REACTION OF ALIPHATIC KETONES WITH OXYGEN-18. R. Srinivasan (IBM Watson Research Center, New York). J. Phys. Chem., 68: 1997-2005(July 1964).

The mechanism of the reaction between ^{18}O and diethyl ketone or 5-hexen-2-one was investigated. The results showed that it is possible to increase the quantum yield for the formation of diethyl ketone-^{18}O by exposing the cell to the products of oxidation of the ketone. The history of the cell becomes a relevant factor in this particular photochemical system. It is also evident from experiments on diethyl ketone that even in a conditioned cell, a combination of light and oxygen is essential for the formation of diethyl ketone-^{18}O. Finally it appears that a cell that has been conditioned by the oxidation of diethyl ketone is capable of increasing the quantum yield for the formation of the ^{18}O-labeled species of another ketone, such as 5-hexen-2-one. (P.C.H.)

31606 EVIDENCE FOR HYDROGEN ATOM SCAVENGING IN THE RADIOLYSIS OF CYCLOHEXANE–BENZENE MIXTURES. J. Y. Yang, B. Scott, and J. G. Burr (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 68: 2014-16(July 1964).

Polymer yields in the radiolysis of benzene–cyclohexane mixtures were studied. The results showed that the benzene content in the polymer remains essentially constant at G(benzene → polymer) value about 0.4, whereas the total polymer yield increased as a function of the radiation dose by a relationship not far different from that observed for polymer formation in the radiolysis of cyclohexane alone. The observation of an abnormal tritium isotope effect in the formation of the benzene polymer provided unequivocal evidence that hydrogen atom addition reactions rather than bimolecular processes resulting in the hydrogen abstraction by an excited benzene molecule are involved since the latter process would be expected to show the normal isotope effect of a hydrogen transfer reaction. (P.C.H.)

31607 KINETIC STUDY OF SCINTILLATION IN PURE ORGANIC CRYSTALS. Daniel Blanc, Francis Cambou, Yann Gervais de Lafond (Faculte des Sciences, Toulouse). J. Phys. (Paris), 25: 319-25(Mar. 1964). (In French)

The previous theories of the fast component of organic scintillation are perfected and generalized by setting up a general equation for the variation of the density of the "fast" singlet quanta of excitation. The equation is applied to a less restrictive case than was previously considered. The slow component is then studied, assuming that these quanta are formed by bimolecular activation from the lowest triplet state to the first excited singlet state. The relative importance of the slow component is determined for both particle and photon excitation. (D.C.W.)

31608 IRRADIATION OF POLYETHYLENE CRYSTALS: GAS EVOLUTION STUDIES. R. Salovey, D. L. Malm, A. L. Beach, and J. P. Luongo (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Polymer Sci., Pt. A, 2: 3067-74(July 1964).

Equal radiation yields of hydrogen were obtained from bulk polyethylene and thin films of solution-crystallized polyethylene, with a G value of 4.6. The corresponding value for very thick mats of the solution-crystallized material was 3.4. Reasoning from material balance considerations indicated that the yield of radioinduced crosslinking for bulk and thin films is about twice that for thick mats of polyethylene. It is suggested that thin films and thick mats differ only in fold surface contact, and that crosslinking is preferential at the folds. The retention of xylene between fold surfaces following crystallization is compatible with the effect of irradiation on trapped solvent. (auth)

31609 INVESTIGATIONS ON THE RADIATION-PRODUCED PEROXIDE OF POLY(METHYL METHACRYLATE) AND ITS COPOLYMERS. Stefan Polowinski, Eligia Turska, and Jerzy Kroh (Lab. of Physical Chemistry of High Polymers, Polish Academy of Sciences, Lodz and Technical Univ. of Lodz, Poland). J. Polymer Sci., Pt. A, 2: 3305-9(July 1964).

The concentration of peroxide groups produced in polymethylmethacrylate (PMMA) and PMMA-styrene copolymers (random, graft, and block) irradiated in the presence of air by γ rays from ^{60}Co was determined. The dependence of the concentration on radiation dose and polymer composition was investigated. In copolymers containing more than 10% styrene the number of peroxide groups corresponding to PMMA decreased as the concentration of styrene increased. This phenomenon was ascribed to the transfer of energy toward benzene rings. The influence of these rings was much stronger in block and graft copolymers than in the statistic ones. In the case of small quantities of polystyrene in random copolymers there was a certain increase of the number of peroxide groups in comparison with pure PMMA. (auth)

31610 γ-IRRADIATION- AND RADICAL-INITIATED POLYMERIZATION OF N,N-DIMETHYLETHENESULFONAMIDE. Richard H. Wiley and Peter Jaeger (Univ. of Louisville, Ky.). J. Polymer Sci., Pt. A, 2: 3327-31(July 1964).

The gamma-induced polymerization of N,N-dimethylethenesulfonamide, mp −3 to −2°C, was studied in the liquid, supercooled liquid, and solid states from −50 to +42°C. The polymerization was relatively slow (0.8%/hr) at 0.13 Mr/hr and was inhibited in the solid state. The activation energy (−16°C super-cooled liquid to 42°C), −2.4 kcal/mole, indicated an ionic process. The radical-initiated (peroxide, azobisisobutyronitrile, ultraviolet) polymerization gave low

molecular weight products. The marked decrease in rate for the N,N-dimethyl derivative as compared to that for ethenesulfonamide itself was attributed to an increased irradiation instability associated with N-methyl structures, which parallels that for amides and N-methylamides in carbon tetrachloride. (auth)

31611 GRAFT COPOLYMERIZATION BY PRE-IRRADIATION METHOD—EFFECTS OF WATER AND VARIOUS METHODS OF CONTACT OF MONOMER. Sadao Torikai and Eiji Mukoyama (Toyo Rayon Co., Ltd.). Kobunshi Kagaku, 21: 120-3(Feb. 1964). (In Japanese)

Vinylpyrrolidone was grafted in its aqueous solution on to various kinds of polymers (polyethylene, polypropylene, nylon-6, and viscose rayon) by a pre-irradiation method. The accelerating effect of water on the grafting, generally recognized for grafting onto hydrophilic polymers, is also found for hydrophobic polymers. This effect, however, cannot be observed in grafting at high temperature in some systems. Various kinds of monomers (styrene, methyl methacrylate, methyl acrylate, and acrylonitrile) were grafted in their emulsions onto the above polymers. In this method, the grafting does not depend on the monomer concentration in the broad range. This grafting is regarded as a special case of grafting in aqueous solutions of the monomer. Furthermore, the grafting of methyl methacrylate onto polypropylene in its monomer vapor is similar to that in its monomer liquid, for the layer of monomer might cover the surface of the polymer in case of grafting in the vapor phase. (auth)

31612 SOME PROPERTIES OF POLYPROPYLENE FIBER GRAFTED WITH VINYL ACETATE BY PRE-IRRADIATION METHOD AND ITS DERIVATIVE BY SAPONIFICATION. Sadao Torikai and Masami Kubo (Toyo Rayon Co., Ltd., Japan). Kobunshi Kagaku, 21: 132-7 (Feb. 1964). (In Japanese)

Polypropylene fiber was grafted in emulsion with vinyl acetate by a pre-irradiation method and its derivative was obtained by saponification. These grafted polypropylene fibers were examined as to mechanical and thermal properties and dyeability. Grafting of vinyl acetate induced cracking in the interior of the polypropylene fiber. Other kinds of monomers such as styrene, methyl methacrylate, acrylonitrile did not induce the cracking. The dyeability for disperse dyes was examined with respect to the change of the partition constant of dyes with the monomer grafted percents. Although the elasticity of elongation of the vinyl acetate-grafted polypropylene decreased rapidly with graft percents, that of the derivative by saponification was not affected at all. The thermal contraction of the fibers was increased by these graftings. A high flow resistance in melt was observed, though these grafted fibers were soluble in decaline. (auth)

31613 STUDIES ON THE RADIATION-INDUCED GRAFT-COPOLYMERIZATION OF POLY(VINYL CHLORIDE) BY THE TECHNIQUE OF PRE-IRRADIATION IN AIR. G. Zeppenfeld and L. Wuckel (Institut für Angewandte Physik der Reinstoffe, Deutsche Akademie der Wissenschaften, Dresden). Monataber, Deut. Akad. Wiss. Berlin, 6: 251-2(1964).

The technique involving pre-irradiation in air was applied to studies of the radioinduced graft-copolymerization of polyvinyl chloride foil. The results showed that the reaction is a typical radical polymerization reaction and that the course of the reaction is not influenced by the pre-irradiation in presence of air. (OTS)

31614 INVESTIGATIONS ON THE RADIO-CHEMICAL GRAFTING COPOLYMERIZATION OF PVC BY THE METHOD OF PRELIMINARY IRRADIATION IN AIR. G. Zeppenfeld and L. Wuckel (Institut für Angewandte Physik der Reinststoffe, Dresden). Monatsber. Deut. Akad. Wiss. Berlin, 6: 251-60(1964). (In German)

The legitimacy of the method of preliminary irradiation in air in radiochemical grafting copolymerization was investigated by the grafting of acrylonitrile to PVC. PVC foils were irradiated with ^{60}Co γ radiation at room temperature in air, and then heated in acrylonitrile for the copolymerization. The ungrafted PVC was then dissolved out with tetrahydrofuran, and the grafting yield was determined. The results obtained were typical for a pure radical grafting. The presence of air in the irradiation, therefore, has no effect on the character of the grafting reaction. (J.S.R.)

31615 EFFECT OF AROMATIC GROUPS ON THE RADIATION STABILITY OF GLYCOSIDES. Glyn O. Phillips (University Coll., Cardiff, Wales), Florine A. Blouin, and Jett C. Arthur, Jr. Nature, 202: 1328-9 (June 27, 1964).

The behavior of a number of glycosides on γ irradiation was examined, and G values were obtained from initially linear yield-dose curves. Aromatic groups forming the aglycon were found to stabilize the glycosidic group strongly toward radiation scission. (C.E.S.)

31616 NITROUS OXIDE AS A SCAVENGER FOR ELECTRONS IN THE RADIOLYSIS OF PROPANE. G. R. A. Johnson and J. M. Warman (Univ. of Newcastle-upon-Tyne, Eng.). Nature, 203: 73-4(July 4, 1964).

The effect of N_2O in the gamma radiolysis of propane gas was investigated, and information on the mechanism of hydrogen formation was obtained. The yield of hydrogen from pure propane was found to be $G(H_2) = 6.5$. Addition of N_2O decreased the yield of H_2 and led to the formation of N_2. The yields of H_2 and of N_2 were independent of the N_2O concentration between 2 and 4 mole per cent. The results seem to indicate that N_2 is formed by the reaction of electrons with N_2O. (C.E.S.)

31617 EFFECTS OF GAMMA RAYS ON THE GROWTH OF KCl. D. N. Kumar (P. O. Magra, Dist. Houghly, West Bengal, India). Naturwissenschaften, 51: 286(1964). (In German)

The effects of gamma rays on the physical properties of KCl crystals during crystallization were studied. The supersaturated filtered solution was irradiated with a ^{60}Co gamma source at a rate of 72.4 r/hr to a total dose of 12,923 r. The KCl crystals showed a specific gravity of 1.737 whereas the specific gravity of normal KCl is 1.984. It was concluded that the chief reason for this is the formation of vacancies by the removal of ion pairs from the interior of the lattice an attachment on the surface of the crystal. (M.C.G.)

31618 RADIATION COPOLYMERIZATION OF ETHYLENE AND CARBON MONOXIDE. E. E. Braudo and A. I. Dintses (All-Union Scientific Research Inst. for Petroleum Reprocessing, [Academy of Sciences,] USSR). Neftekhimiya, 4: No. 1, 68-76(1964).

The process of copolymerization of ethylene and carbon monoxide was studied in the gaseous phase, at 25 to 215°C and a pressure up to 300 bar, initiated by the gamma radiation from ^{60}Co. The relative activities found at 70°C were $r_{C_2H_4} = 0.16$; $r_{CO} = 0$. The dependence of the quantity $r_{C_2H_4}$ on temperature was studied. The copolymerization of ethylene and carbon monoxide was conducted in the presence of benzene; the properties of the products formed were found to differ from those of the copolymers produced in the gaseous phase. The benzene copolymers possessed

higher melting points, a lower rate of the reaction with dilute hydroxylamine solution, and complete insolubility in hot pyridine. The composition of the copolymers formed in this case indicated homogeneous occurrence of the copolymerization in the presence of benzene. (OTS)

31619 KINETICS AND MECHANISM OF RADIATION POLYMERIZATION IN LAMINAR OCCLUSION COMPOUNDS OF MONTMORILLONITE. O. L. Glavati and L. S. Polak (Inst. of Petrochemical Synthesis, Academy of Sciences, USSR). Neftekhimiya, 4: No. 1, 77-81(1964).

The basic principles of radiation polymerization of acrylonitrile in occlusion compounds of montmorillonite were studied. A radical mechanism for this type of polymerization was proposed on the basis of data obtained on the dose and temperature dependence of the polymer yield. A three-dimensional scheme of the course of the polymerization in the laminar occlusion compound of montmorillonite, agreeing with all the data obtained, was proposed. The polymers formed in two-layer occlusion compounds apparently represented two-dimensional networks, crosslinked from syndyotactic chains. (OTS)

31620 IONIC THERMOCONDUCTIVITY OF X-IRRADIATED Sr DOPED KCl. M. Beltrami, R. Cappelletti, and R. Fieschi (Universita, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Phys. Letters, 10: 279-80 (June 15, 1964).

It is shown from ionic thermoconductivity measurements that x irradiation of Sr doped KCl is accompanied by a considerable decrease of the number of impurity-vacancy complexes; and therefore, the creation of F centers should be due mainly to the conversion of cation vacancies bound in the dipolar complexes. (L.B.S.)

31621 ENERGY TRANSFER FROM 3d TO 4f ELECTRONS IN $LaAlO_3$:Cr, Nd. J. Murphy, R. C. Ohlmann, and R. Mazelsky (Westinghouse Research Labs., Pittsburgh). Phys. Rev. Letters, 13: 135-7(July 27, 1964).

Energy transfer between 3d levels of Cr^{3+} and the 4f levels of Nd^{3+} in $LaAlO_3$ was observed. Evidence for the transfer is the observation of Nd^{3+} fluorescence when the wavelength of the exciting light falls in a region where only Cr^{3+} absorbs. The room-temperature fluorescence spectrum, covering the region from 0.7 to 1.1 μ, of a powder containing 2% Nd and 0.5% Cr is illustrated. (C.E.S.)

31622 RADIATION GRAFTING OF 2-METHYL-5-VINYLPYRIDINE ON POLYETHYLENE. N. S. Tikhomirova, V. I. Serenkov, and E. I. Kraevskaya. Plasticheskie Massy, No. 3, 4-5(1964).

The conditions for radiation grafting of 2-methyl-5-vinylpyridine on polyethylene and the properties of the resultant copolymers were studied. Experiments were conducted under vacuum and in air using ^{60}Co; with this gamma irradiation the grafting rate was high even in air; a free radical mechanism is suggested. Increasing the 2-methyl-5-vinylpyridine content in the copolymer increased mechanical strength: with 300% graft onto polyethylene, the strength was increased 2.65 times over the original. Additional grafting of 2 to 10% divinylbenzene to form a polyethylene-2-methyl-5-vinylpyridine-divinylbenzene system significantly increased the mechanical strength above that of the two component polymer. The polyethylene-2-methyl-5-vinylpyridine copolymers appeared homogeneous, transparent, and slightly yellow. (OTS)

31623 TEMPERATURE DEPENDENCE OF THE SECONDARY ISOTOPE EFFECT ON AQUEOUS ALKALINE ESTER HYDROLYSIS. E. A. Halevi and Zafra Margolin (Israel Inst. of Tech., Haifa). Proc. Chem. Soc., 174(June 1964).

An investigation was made on the temperature and solvent dependence of the isotope effect in the aqueous alkaline hydrolysis of ethyl trideuteroacetate. From the results, it is suggested that the occurrence of an extremum near 25°C, just where the dissociation constants of acetic and other similarly weak aliphatic acids take on maximum values, is evidence that small differences in energy and entropy of solvation, resulting from isotopic differences in average charge distribution, largely determine the secondary isotope effects in this and other highly aqueous systems. Considerations similar to those applied to secondary isotope effects on aqueous solvolysis of alkyl halides and sulfonates, reproduce the qualitative features of the temperature dependence satisfactorily. (P.C.H.)

31624 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. I. GRAFTING OF STYRENE ONTO COTTON BY PRE-IRRADIATION WITH ELECTRON BEAMS. I. Sakurada, T. Okada, and F. Kimura. Seni-i Gakkaishi, 18: 687-93(Aug. 1962). (In Japanese)

Cotton was irradiated in air by a Van de Graaff accelerator, and then brought into contact with methanol solution of styrene (containing ~5% of H_2O) in vacuo at various temperatures. Styrene grafted readily at dosages of the order of 1 Mrad. At a constant intensity of 2.0×10^4 rad/sec, grafting of styrene increased with the total dosage. Its optimum temperature was 50°C. At a constant total dosage, the grafting rate was independent of the irradiation intensity between 2.0×10^3 and 1.0×10^5 rad/sec. Almost no grafting reaction was observed when it was carried out in air. The effect on grafting in the presence of Fe^{2+} ions was also studied. In vacuo, Fe^{2+} accelerated the process at low temperatures, but not at 50 and 80°C. In air, grafting occurred to a considerable extent when the monomer solution contained ferrous ions. (OID)

31625 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. II. EFFECT OF SOLVENT ON THE GRAFTING OF STYRENE ONTO COTTON. I. Sakurada, T. Okada, and F. Kimura. Seni-i Gakkaishi, 18: 693-8(Aug. 1962). (In Japanese)

Cotton irradiated by electron beams in air was grafted smoothly by styrene in vacuo at 50°C in methanol solution without water, and its grafting rate was rather high when compared to that in a monomer solution containing water. Test results showed that methanol, ethanol, and propanol were effective for grafting, whereas butanol and amyl alcohol were not. Cotton irradiated in various solvents showed almost the same grafting rates. The active center for grafting decayed more or less rapidly by heating in air or water. When irradiation was carried out with a 1000-C ^{60}Co γ source, the grafting rate onto the cotton irradiated in vacuo was twice that in air, and it was deterred when irradiated in C_6H_6. Acrylic acid grafted readily onto cotton but a considerable amount of homopolymer was produced. (OID)

31626 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. IV. GRAFT POLYMERIZATION OF STYRENE TO COTTON FABRIC WITH IMBIBED WATER INDUCED BY γ-RADIATION. I. Sakurada and Y. Sakaguchi. Seni-i Gakkaishi, 18: 834-8(Sept. 1962). (In Japanese)

The simultaneous grafting technique of styrene onto cotton fabric imbibed with H_2O induced by a 2000-C ^{60}Co irradiation facility is described. The effects of the H_2O content (0 to 200%) in the fabric, quantities of styrene (45 to 4000%), temperature (10 to 70°C), and the atmosphere (air and N_2) on the grafting rate and efficiency were studied. Results indicated that the most important factor in grafting (highest value of ~70%) is water in the fabric under favorable

conditions, i.e., rapid increments were observed with 60% water content at ~30°C, irradiated in N_2, at a dosage of 1×10^6 r, and the addition of a small amount of divinylbenzene. The grafting rate seemed to increase without further marked variations after an initial grafting up to a certain amount of styrene has been grafted. (OID)

31627 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. V. THE ROLES OF THE IMBIBED WATER IN THE FABRIC AND THE GRAFTED POLYSTYRENE IN GRAFT POLYMERIZATION OF STYRENE ONTO COTTON FABRIC. I. Sakurada and Y. Sakaguchi. Sen-i Gakkaishi, 18: 838-42(Sept. 1962). (In Japanese)

Based on experimental results, the roles of the imbibed water and partially grafted polystyrene in the grafting process are discussed. The acceleration effect of the imbibed water on the grafting is due mainly to its swelling effect on the fabric, whereby water accompanies styrene monomer into the inner structure of fibers. Polystyrene grafted onto fibers further accelerates the penetration of the styrene monomer into the fiber. The saturation of the grafting and the gel effect in the polymerization were also considered. (OID)

31628 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. VI. GRAFT POLYMERIZATION OF STYRENE TO DRY COTTON FABRIC INDUCED BY γ-RADIATION. I. Sakurada and Y. Sakaguchi. Seni-i Gakkaishi, 18: 919-24(Oct. 1962). (In Japanese)

Dry-cotton samples were irradiated with ^{60}Co γ rays in styrene-organic solvent mixtures with CH_3OH, C_2H_5OH, n-C_3H_7OH, n-C_4H_9OH, n-$C_5H_{11}OH$, C_2H_3COOH, acetone, dioxane, dimethyl formamide, dimethyl sulfoxide, ethyl acetate, ethyl ether, petroleum benzine, $CHCl_3$, CCl_4, C_6H_6, xylene, and $C_6H_5NO_2$. The effects of the characteristics and proportion of the solvents, amount of styrene, temperature, and atmosphere on the grafting rate and efficiency were studied. The tabulated results at 10, 20, 30, and 30 to 70°C are discussed. The presence of 1% of a solvent in styrene induced marked acceleration in grafting and was justified by its swelling effect on the fiber. The optimum grafting conditions with these solvents were up to a dosage of 5×10^4 r for 15-min irradiation. (OID)

31629 STUDIES ON GRAFT POLYMERIZATION ONTO COTTON. VII. GRAFT POLYMERIZATION OF STYRENE ONTO VARIOUS CELLULOSES BY A SIMULTANEOUS GRAFTING TECHNIQUE WITH γ-RAYS. I. Sakurada and Y. Sakaguchi. Seni-i Gakkaishi, 18: 924-8(Oct. 1962). (In Japanese)

Studies on the grafting of styrene onto various celluloses, i.e., cotton fiber and fabric, mercerized cotton fabric, and various rayon fibers, and fabrics by a simultaneous grafting technique with ^{60}Co γ rays were undertaken. When cellulose samples contained a sufficient amount of water almost all rayon samples reacted more readily than cotton. But when dry samples were irradiated in styrene solutions, some rayon samples were grafted more readily and the others more slowly than cotton. The order of the grafting rate for various cellulose samples was changed according to the grafting conditions. These results may be explained by the difference in the crystallinity and fine structure of the samples. The cotton fiber and fabric were grafted with nearly the same rate. The degrees of swelling of the styrene-grafted cotton fabrics were measured in C_6H_6 at 30°C. The values depend not only on the degree but also on the grafting condition. (OID)

31630 STUDIES ON GRAFT POLYMERIZATION TO COTTON. IX. GRAFT POLYMERIZATION OF STYRENE TO DRY COTTON IMBIBING CATALYSTS. I. Sakurada and Y. Sakaguchi. Seni-i Gakkaishi, 19: 221-4(Mar. 1963). (In Japanese)

Cotton fabric was immersed in solutions containing KPS, AIBN, or BPO, then dried at room temperature. Such fabrics imbibing catalysts were heated with styrene-methanol mixtures in sealed tubes. The effects of various factors such as composition of styrene solutions, temperature, and time of heating on the graft polymerization were examined. KPS was the most suitable catalyst, and the graft polymerization proceeded smoothly under suitable conditions. In another series of experiments, dry cotton fabrics imbibing catalysts were heated alone and then heated again with styrene solutions in sealed tubes. No desirable results were obtained by this method. Some experiments were also performed to determine the effects of the irradiation on the grafting of styrene onto cotton fabrics imbibing catalysts. (OID)

31631 ON THE EFFECTS OF γ-RAYS IRRADIATION ON SEVERAL FACTORS OF ELECTROPHORESIS. Shigeichi Achiwa. Shigakenritsu Tanki Daigaku Gakijutsu Zasshi, No. 4, 1-4(Mar. 1963).

The effects of gamma irradiation of the filter paper on adsorption of ions by filter paper, electrophoresis of anions, electro-osmosis of liquid medium, migration of medium, and change of voltage gradient in the middle of the filter paper during electric discharge were studied. Irradiation of the filter paper decreased the electrophoresis. (M.C.G.)

31632 CHEMICAL EFFECT ON NUCLEAR TRANSFORMATION IN SOLIDS. (CHEMICAL EFFECTS ON NUCLEAR RECOIL). A. N. Murin, R. V. Bogdanov, and S. M. Tomilov. Usp. Khim., 33: 619-47(May 1964). (In Russian)

Nuclear reactions and radiation capture of neutrons in ionic crystals are reviewed. Methods for determining the chemical state of recoil atoms in crystals, recoil energy losses, hot region reactions and parameters are discussed. The influence of cations, structural deformation, irradiation temperature, and pH of the dissolving medium on the retention process are evaluated and the effects of Mössbauer effect in hot atom chemistry are analyzed. 82 references. (R.V.J.)

31633 ESR INVESTIGATIONS ON THE SELF-RADIOLYSIS OF TRITIUM-LABELED AMINO AND DICARBOXYLIC ACIDS. G. Lassmann and W. Damerau (Institut für Biophysik, Deutsche Akademie der Wissenschaften, Berlin). Z. Naturforschung, 19a: 661-2(May 1964). (In German)

The radical yield of tritium-labeled amino and dicarboxylic acids was determined using an X band electron spin resonance spectrometer. The acids and asparagine were labeled by the Wilzbach exchange method or with tritium water. The labeled materials were then stored until the β decay was sufficiently large. For the radical yield determination, the spectrum of a sugar charcoal standard was measured under the same conditions. The results are tabulated and show that the number of formed and stabilized radicals is significantly higher than the number of β decays. The principal origin of the radical formation is therefore from the interaction of the β particle. The results are discussed. (J.S.R.)

31634 SYNTHESIS OF OXYGEN-LABELED HYDROGEN PEROXIDE FROM DISSOCIATED HEAVY OXYGEN WATER IN THE GLOW DISCHARGE. I. I. Vol'nov, A. V. Tsentsiper, V. N. Chamova, E. I. Latysheva, and Z. I. Kuznetsova. Zh. Fiz. Khim., 38: 1182-7(May 1964). (In Russian)

A laboratory method was devised for preparing oxygen-labeled hydrogen peroxide from dissociated heavy-oxygen water in a glow discharge. The method differs from those used previously in that the heavy-oxygen peroxide is of a high degree of purity and not only the entire heavy oxygen contained in the initial water passes over into the peroxide, but the latter is somewhat enriched in ^{18}O. The method has also the advantage of yielding solutions of oxygen-labeled hydrogen peroxide ranging from 1 to 50%, depending upon the energy supply of the discharge and the rate of supply of water vapor. Yields in the case of 5 to 7% solutions equaled 1g/hr on a 100% $H_2O_2^*$ basis. Using the same apparatus, the $H_2O_2^*$ synthesized in the discharge can be concentrated to 90% by weight. (auth)

31635 RADIOLYSIS AND RADIATION OXIDATION OF PIPERIDINE. A. P. Podsoblyaev and N. A. Bakh (Moscow State Univ.). Zh. Fiz. Khim., 38: 1318-20(May 1964). (In Russian)

The effects of ionizing radiation were studied using oxygen-saturated and degassed specimens of piperidine exposed to x- and γ-ray doses from 2.3×10^{14} to 2×10^{16} ev/g sec at temperatures from 6 to 80°C. The radiolysis products of evacuated piperidine, H_2 and tetrahydropyridine, formed in equimolar quantities yielding 2.9 ± 0.1 and 2.8 ± 0.2 molecules per 100 ev, respectively. Irradiation of oxygen-saturated pyridine in the temperature range from 6 to 30°C produced hydrogen peroxide with a yield of 5.3 molecules/100 ev; at a temperature of 80°C the yield of hydrogen peroxide increased to 136. (R.V.J.)

31636 INVESTIGATIONS OF RADIATION STABILITY OF CERTAIN SINGLE-FUNCTION ANIONITES. Yung-sheng Lu, I. A. Kuzin, and A. M. Semushin. Zh. Prikl. Khim., 37: 893-5(Apr. 1964). (In Russian)

Studies were made of the influence of structure on the radiosensitivity of quaternary ammonium groups in water swollen polystyrene ion exchange materials (ASD-2, ASD-3, ASD-4, AB-17, and AMP). It was found that pyridine base ion exchange materials have a high resistance to ionizing doses from 0 to 3.6×10^8 r, while resins with quaternary nitrogen atoms connected to aliphatic radicals have a very low radiochemical resistance. It was postulated that splitting of ion exchange groups is the main process induced by radiation in the swollen anionites. (R.V.J.)

31637 ZUR STRAHLENCHEMIE DES ACETONITRILS. (On the Radiation Chemistry of Acetonitrile). Peter Kohler. Thesis, Berlin, Technische Universität, 1963. 112p.

The radiolysis of acetonitrile was investigated for a gamma dose of about 1.5×10^7 r. The products formed included: high-molecule residues, hydrogen, methane, succinic acid nitrile, hydrocyanic acid, propionitrile, small amounts of ethane, acetylene, nitrogen, ethylene, propane, and traces of additional high-boiling compounds. The formation of the products can be explained by reactions of hot and thermalized radicals. Results were compared with other reactions of acetonitrile. (M.C.G.)

31638 DER EINFLUSS DES SPEZIFISCHEN ENERGIEVERLUSTES BEI DER STRAHLENCHEMISCHEN POLYMERISATION EINIGER VINYLVERBINDUNGEN. (The Influence of Specific Energy Losses on the Radiochemical Polymerization of Some Vinyl Compounds). Juergen Fock. Thesis, Berlin-Charlottenburg, Technische Universität, 1963. 82p.

The polymerization of various vinyl monomers (acrylonitrile, styrol, methylmethacrylate, and vinyl acetate), to which small amounts of boric acid ester were added, was investigated to determine its dependence on the specific energy losses (LET) of the ionizing radiation. Gamma radiation and thermal neutrons were used. For the same absorbed dose rates the velocity of the polymerization excited by particles of higher LET from the nuclear reaction $^{10}B(n,\alpha)^7Li$ was considerably smaller than by gamma irradiation. The average molecular weight was higher than for gamma irradiation. Gravimetric and dilatometric models were used to determine relative composition. (M.C.G.)

31639 SLOW-PROTON IRRADIATION OF POLYETHYLENE TEREPHTHALATE. H. Jung (Kernforschungszentrum, Karlsruhe, Ger.). p.43-55 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (KFK-222)

Epithermal neutrons interact with matter producing recoil protons which in turn transfer energy by ionization and by collision with nuclei. In an attempt to separate the effects produced by these various processes, foils of polyethylene terephthalate (Hostaphan, Melinex, or Mylar) were irradiated with slow protons in the energy range from 2 to 12 kev and the changes of the optical absorption caused by the irradiation measured spectrophotometrically. Densely ionizing radiations (slow protons, 3.4-Mev alpha particles, and 2-Mev protons) induced in Hostaphan a sharp absorption maximum at 308 mμ. At high doses of slow protons this maximum reached a saturation value. The height of this saturation value increased with increasing proton energy. The D_{37} (i.e. dose to reach 63% of the saturation value) for protons from 2 to 12 kev was 4×10^{14} proton/cm^2 (±20%). To produce the maximum at 308 mμ slow protons were more efficient than 3.4-Mev alpha particles (by a factor of 1.2 to 1.7) and 2-Mev protons (by a factor of 1.7). The reason postulated was that slow protons with velocities appreciably smaller than v_0 ($v_0 = c/137$ = velocity of an electron in the lowest orbit of a hydrogen atom) ionize with a higher probability than generally assumed. Irradiation with low energy protons produced also a broad absorption maximum at 250 mμ, which was not observed after irradiation with 2-Mev protons (in vacuum) or with 3.4-Mev alpha particles (in helium under atmospheric pressure). At higher doses this maximum also reached a saturation value, but this value was equal for all proton energies between 2 and 12 kev and corresponded to a D_{37} of 0.8×10^{14} proton/cm^2. This maximum was thought to be due to a mechanism that has an appreciable efficiency only below 2 kev proton energy. The nature of this mechanism is unknown, but it may be caused either by a chemical reaction of the zero energy protons with the plastic molecules or by elastic collisions of the protons with atomic nuclei. However, this mechanism (as evident from the D_{37} values) was more efficient in changing the properties of Hostaphan than the ionization mechanism of densely ionizing radiation (slow protons or 2-Mev protons, respectively). The experiments showed that the energy of very slow protons, which are produced by epithermal neutrons, is transferred to matter not only by ionization processes but also by another mechanism occurring at low proton energies. This mechanism of energy transfer, if shown to lead to biologically important consequences may have a bearing on setting tolerance limits for epithermal neutrons. (auth)

31640 STUDIES OF PHOTODISSOCIATION OF MOLECULAR IONS. G. H. Dunn (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). p.997-1005 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Preliminary results are reported on the measurement of the photodissociation cross section of H_2^+. Measurements

were made at a number of wavelengths between 3000 and 9000 Å, and a comparison is made with available theory. Disagreement of the measurements with theory suggest that improvement of the theory is justified for detailed comparisons with experiment. A linear decrease with ion source pressure of the photodissociation cross section at 5500 Å is observed. This dependence yields a lower limit of 10^{-15} cm^2 on the collision cross section for depopulating vibrational states of H_2^+ participating in photodissociation at 5500 Å. White light was also used to observe photodissociation of H_3^+ and N_2^+, and an average cross section was calculated from the data and the spectral distribution of the lamp used. An effort to observe photodissociation of H_3^+ yielded no results except to place an upper limit of 10^{-20} cm^2 on the average cross section. (auth)

31641 FACTORS GOVERNING RADIATION RESISTANCE OF POLYATOMIC MOLECULES. B. K. Krotoszynski (Illinois Inst. of Tech., Chicago). 7p. (CONF-543-4)

From American Physical Society 1964 March Meeting, Philadelphia, Mar. 1964.

The radiation behavior of pure ferrocene in a high-energy electron field was investigated. Radiation resistance of ferrocene was evaluated in terms of the G-values of the final chemical products that comprised hydrogen, C_5-hydrocarbons, and metallic iron. Primary radiation events were examined in the light of certain structural features of the ferrocene molecule. It was concluded that the observed high radioresistance of ferrocene can be ascribed to a set of special molecular properties that constitute an inherent and efficient mechanism for energy dissipation. These include low ionization potential, high degree of resonance, molecular symmetry, and low-lying stable excited electronic states. (P.C.H.)

31642 IMPROVEMENTS IN OR RELATING TO SCINTILLATORS. Richard Lawrence Macklin (to United Kingdom Atomic Energy Authority). British Patent 960,448. June 10, 1964. Filed Feb. 27, 1961.

A liquid scintillator, comprising a mixture of alkyl naphthalene solvent containing primary and secondary solute and glass particles, the glass and liquid scintillators having matched refractive indices, is described. It is found to be very efficient for detecting high-energy gamma rays. (L.B.S.)

31643 PROCESS FOR THE PREPARATION OF AROMATIC COMPOUNDS CONTAINING DEUTERIUM, TRITIUM, OR THE CARBON ISOTOPE $^{14}_{6}C$. (to CIBA Ltd.). British Patent 961,576. June 24, 1964. Priority date Nov. 18, 1960, Switzerland.

A process for the manufacture of a monocyclic aromatic hydrocarbon containing more than the naturally occurring proportion of deuterium, tritium, and carbon-14 is presented. The process consists of subjecting an acetylenically unsaturated hydrocarbon containing more than the naturally occurring proportion of deuterium, tritium, and carbon-14 to the action of a cyclization catalyst of a halogen-containing compounds of niobium, tantalum, or tungsten at a pressure of 100 to 2000 mm Hg. (C.E.S.)

31644 GRAFT COPOLYMERS. (to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). British Patent 961,940. June 24, 1964. Priority date Aug. 7, 1959, France.

Graft copolymers and methods for producing them by irradiation grafting a mixture of butadiene and a vinyl monomer onto polyvinyl chloride are discussed. The vinyl monomers consist of vinyl pyridine, alkyl acrylate, alkyl methacrylate, or acrylonitrile or their mixtures. A cobalt-60 gamma source is used. (C.E.S.)

31645 RADIOACTIVE CARRIER COMPOSITIONS. (to Abbott Labs.). British Patent 962,582. July 1, 1964. Priority date Oct. 26, 1960, United States.

Methods for preparing solid radioactive synthetic resin compositions by combining an epoxy resin with a curing agent of amine, polyamide, or amine-polyamide adduct are described. Several examples are given. (L.B.S.)

31646 IMPROVEMENTS IN OR RELATING TO SCINTILLATION COUNTERS. Gerard Chevalier (to Commissariat a l'Energie Atomique). British Patent 963,485. July 8, 1964. Priority date Nov. 19, 1959, France.

A process for the manufacture of a scintillation counter based upon zinc sulfide (silver activated) dispersed in a resin or plastic varnish and deposited on a solid plastic or metallic support is described. This process yields products of a regular quality, having more satisfactory characteristics and obtained with less cost than some previous methods. (L.B.S.)

Separation Processes and Procedures

31647 (A/CONF.28/P/250) FLUORIDE VOLATILITY PROCESSES FOR THE RECOVERY OF FISSIONABLE MATERIAL FROM IRRADIATED REACTOR FUELS. R. C. Vogel (Argonne National Lab., Ill.), W. H. Carr, G. I. Cathers, J. Fischer, L. P. Hatch, R. W. Horton, A. A. Jonke, R. P. Milford, J. J. Reilly, and G. Strickland. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A survey is presented of U. S. work on fluoride volatility separations processes which was carried out since the 1958 Geneva conference. The work includes processes for high- and low-enrichment fuels, fused salts, fluidized beds, processes for graphite-matrix fuels, Nitrofluor process, and processes for plutonium-containing fuels. (D.L.C.)

31648 (A/CONF.28/P/251) PYROMETALLURGICAL AND PYROCHEMICAL FUEL PROCESSING. Leslie Burris, Jr. (Argonne National Lab., Ill.), K. M. Harmon, G. E. Brand, E. W. Murbach, and R. K. Steunenberg. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Pyrometallurgical and pyrochemical processes in various stages of development that are available for processing nuclear fuel materials are described. These include: EBR-II Fuel Cycle Facility and associated processes, such as melt refining, and skull reclamation and blanket processes; liquid metal processes for U–Pu fuels; Hanford salt cycle process; AIROX process; and processes for carbide fuels, such as oxidation-carbothermic reduction and nitride-carbide processes, and molten salt electrolysis. Even though these processes offer promise for decreasing fuel cycle costs, they lack the economic and engineering evaluation and the confidence that are engendered by sustained operation of a large-scale processing plant. However, it is speculated that the impending operation of the EBR-II Fuel Cycle Facility will go far in providing information concerning the large-scale operation of pyrometallurgical processes. (P.C.H.)

31649 (A/CONF.28/P/252) LARGE-SCALE FISSION-PRODUCT RECOVERY. R. E. Tomlinson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), B. F. Judson, and L. L. Zahn. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Methods used for separating and transporting large quantities of fission products (Ba–La, Sr, Ce, Pm, Zr, Cs, Tc, Kr, and Xe) are outlined. Future production plans are discussed. (T.F.H.)

31650 (A/CONF.28/P/278) SAFETY ASPECTS OF U. S. FUEL REPROCESSING. J. A. McBride (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho), E. B. Sheldon, W. S. Frank, and J. C. Bresee. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of the safety procedures and experience at U. S. fuel reprocessing plants. The probable causes of the five criticality incidents are outlined. It is shown that administrative controls are gradually being replaced by geometrically favorable equipment and nuclear poisons. (D.L.C.)

31651 (A/CONF.28/P/280) SAFETY ASPECTS OF THE EBR-II REPROCESSING FACILITY. Milton Levenson (Argonne National Lab., Ill.), Charles E. Stevenson, and James C. Hesson. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The EBR-II Fuel Cycle Facility was constructed to test pyrometallurgical methods of processing irradiated fuels and remote fuel fabrication techniques. A discussion is presented on the safety aspects of the facility: shielding, radiation monitoring, radioactivity control, fire prevention, and nuclear safety. (D.L.C.)

31652 (A/CONF.28/P/281) SAFETY AND SITING CONSIDERATIONS IN THE DESIGN OF THE NFS POWER FUEL REPROCESSING PLANT. T. Charles Runion (Nuclear Fuel Services, Inc., Washington, D. C.) and Walton A. Rodger. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The Nuclear Fuel Services power fuel reprocessing plant, the first such privately owned plant, is being built for the processing of any type of fuel elements. The plant will be located in the Western New York Service Center in Cattaraugus County. The site study carried out for the plant is described: population, meteorology, geology, waters, and seismology. Safety analyses of plant discharges were carried out for both normal and abnormal operations. It is believed that the long-lived isotopes ^{85}Kr and tritium will dictate the upper limits of processing rate at which the plant may operate. ^{131}I will be reduced by storage of the fuel prior to processing. (D.L.C.)

31653 (COO-770-12) THE SEPARATION OF SOME OF THE RADIOACTIVE FISSION PRODUCTS BY ELECTRODIALYSIS. William H. Webb (Missouri. Univ., Rolla. School of Mines and Metallurgy). June 15, 1964. Contract AT(11-1)-770. 61p.

Preliminary studies were made of the possible fractionation of fission products in waste solutions by electrodialysis using ion exchange membranes. The results demonstrated that several of the fission products can be separated in this way. ZrF_6^{2-} and TcO_4^- are transferred into an anion cell, Cs^+ and Sr^{2+} into a cathode cell, and the rare earths remained in the feed cell as radiocolloids. EDTA was found useful in the separation Sr from Cs, and the separation of Zr from Tc should also be feasible. Separation of rare earths will be difficult. Studies were made of the effects of radiation on the capacity and other properties of ion exchange membranes, and the results indicate that the useful membrane life will be the amount of time required to reach a dose of 10^8 to 10^9 r. (D.L.C.)

31654 (HW-55735) REMOVAL OF RADIO-IODINE FROM PUREX OFF-GAS WITH NITRIC ACID AND WITH NITRIC ACID-MERCURIC NITRATE SOLUTIONS. R. W. Stromatt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1958. Contract AT(45-1)-1350. 10p.

The comparison of the removal of iodine vapor from a gas stream by nitric acid solutions with and without mercuric ion was studied under the conditions obtained when the iodine concentration in the gas stream, the flow rate of the gas stream, and the concentration of mercury in the scrub solutions were varied. Also this removal was studied with and without nitric oxide in the gas stream, at the acid concentration limits expected in the scrub solution, and at 40°C and at room temperature. The greater the concentration of mercury in the scrub solution, the less effect the flow rate had upon iodine removal. However, at iodine concentrations approaching the concentration expected in the plant gas stream, the flow rate did not effect the iodine removal by scrub solutions in the absence of mercury, at least over the range investigated. At high iodine concentrations, the mercury scrub solution appeared more effective at 40° than at room temperature, while the opposite appeared true in the absence of mercury. At low iodine concentrations, there was little difference in the iodine removal by any of the scrub solutions at the two temperatures. Little difference was found in iodine removal by any of the scrub solutions at concentrations of five and ten percent nitric acid. The presence or absence of nitric oxide in the gas did not noticeably alter the iodine removal by the scrub solutions. The mercury solutions were effective at high iodine concentrations if the mercury were in excess over the iodine. At low concentrations of iodine, the acid solution alone was as effective as the mercury solution in removing the iodine from the gas. An air sparge of nitric acid solutions of iodine showed greater than 99.5 percent retention of iodine if the iodine was less than 10^{-6} M. For the mercuric solution to be effective in removing iodine from the gas and retaining it, the molarity of the mercury should be greater than the iodine molarity (as I_2) in the scrub solution. This indicated that higher iodine complexes, such as the HgI_4^{2-} complex ion, were not very stable in the system studied. However, nitric acid solutions without mercury were about as effective as with mercury in the concentration range of iodine in the plant gas stream. Therefore, there appears to be little advantage to the use of mercury except, perhaps, to control large bursts of iodine. (auth)

31655 (HW-79762(Pt.1)) SOLVENT EXTRACTION OF STRONTIUM, CERIUM AND RARE EARTHS WITH D2EHPA. PART 1. LABORATORY STUDIES. W. W. Schulz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1964. Contract AT(45-1)-1350. 56p.

A solvent extraction process for separating strontium and rare earths from Purex process acid waste has been developed. The extractant is di-(2-ethylhexyl) phosphoric acid (D2EHPA) dissolved in a tributyl phosphate and hydrocarbon diluent. There are two product streams; one contains the strontium and the other contains the rare earths. (auth)

31656 (HW-SA-3139) MATHEMATICAL DETERMINATION OF CONCENTRATION PROFILES IN TWO-PHASE CONTINUOUS COUNTERCURRENT EXTRACTORS. N. P.

Wilburn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 7, 1963. Contract AT(45-1)-1350. 36p.

The differential equations describing the mass transfer process are derived for a two-phase countercurrent extractor in which the volumetric fraction (ϵ_i) of the phases is not constant. These equations are solved for the special case where the axial boundaries of the extractor do not correspond to the feed stream inlet points, but are located above and below these points. The results obtained are compared to those obtained by Miyauchi for the cases where they do correspond. (auth)

31657 (HW-SA-3549) AN IMPROVED METHOD FOR SEPARATING PROMETHIUM-147 WITH DI(2-ETHYL-HEXYL) PHOSPHORIC ACID. W. C. Johnson, Jr. and M. H. Campbell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1964. Contract AT(45-1)-1350. 14p. (CONF-606-3)

From American Chemical Society Northwest Regional Meeting, Spokane, Wash., June 1964.

The separation of promethium from a mixed fission product solution is obtained by controlling the aqueous phase acidity between 0.01 M HNO_3 and 0.15 M HNO_3 and extracting into a 1.5 M D2EHPA-toluene organic matrix. The loaded organic is then contacted with 1.0 M HNO_3, simultaneously stripping and decontaminating the promethium fraction from the major fission products and yttrium. Separation from cerium is made by oxidizing the cerium to Ce^{+4} with saturated sodium dichromate and extracting the cerium into 0.5 M TTA-xylene and stripping into 10 M HNO_3. Praseodymium is allowed to decay (T 1/2 = 17.3 min) for at least 2 hours and then the mounted promethium fraction is counted on a beta proportional counter. A calculated promethium yield of 95% was found on 43 analyses by 24 different analysts with a standard deviation of ±3.8%. The analysis can be performed in one hour. A detailed procedure is given. (auth)

31658 (IDO-14635) CHEMICAL PROCESSING TECHNOLOGY. Quarterly Progress Report, October–December 1963. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 1964. Contract AT(10-1)-205. 40p.

Zirconium fuel processing facilities at the ICPP are being modified to dissolve PWR seed fuel. Decladding of advanced PWR fuel proceeded rapidly in dilute hydrofluoric acid but excessive amounts of the uranium in the core also dissolved; attempted continuous integral dissolution of the fuel appeared impractical because of the diverse rates of dissolution of the cladding and the oxide core. Satisfactory batch dissolutions of the fuel were conducted in hydrofluoric acid–oxalic acid mixtures; increased concentration of either reagent shortened the batch dissolution time although 0.2M oxalic acid was selected as optimum for uranium solubility in the mixed acid system. Fuel from EBR-I Core 3 was dissolved in a Niflex-type solution and adjusted for hexone extraction to demonstrate compatibility with existing ICPP processing equipment. Dissolution of highly irradiated (45 percent burnup) aluminum–uranium alloy in nitric acid was shown to be extremely slow and unaffected by large variations in mercuric nitrate concentration. Caustic or electrolytic dissolution of such fuels may be more practical. Adsorption of dibutyl phosphate on hydrated zirconium oxide and repeated regeneration of the adsorbent with sodium hydroxide demonstrated the effectiveness of the process for removal of TBP decomposition products from the first cycle extraction system. In the event an adsorbent bed must be removed, dissolution in nitric acid was demonstrated to be possible. Electrolytic dissolution tests in the Model 2 dissolver demonstrated the effects of a number of variables on solution contact dissolution of simulated APPR and Pathfinder stainless steel elements. Fuel charge heel cleanout was excellent with only 2.8 grams of heel being left after a batch charge of 1664 grams. However, a fine sand-like grey sludge (predominantly stainless steel particles) has been present in all product solutions in amounts up to 2 g/l. Tests indicate this material will dissolve if maintained in suspension in the electric field. Preliminary laboratory studies indicate the possible applicability of alternating current to electrolytic dissolution. The Waste Calcining Facility began processing high-level radioactive waste from ICPP underground storage tanks and operated without incident at design capacity. The changeover from cold to radioactive feed had no significant effect on the process or equipment operation. Release to the atmosphere of the limiting isotopes, strontium-90 and ruthenium-106, was measured. Exploratory investigation of the incorporation of calcined alumina into glasses is reported. Other plant improvement projects reported include: a method for hand computation of pulse amplitudes for columns driven with air pulsers; design of airlift inlet configurations; comparison of packed and pulsed plate columns for Amsco stripping of TBP from first cycle aqueous product; possible reduction in mercuric nitrate catalyst usage by installation of recirculation legs on the aluminum fuel dissolvers; possible production and use of DIBAN by utilization of recirculating dissolvers; corrosion resistance of pyrex glass, neutron-poison vessel packings; and new solubility data for the aluminum nitrate–nitric acid system used in the freeze-melt aluminum waste separation process. (auth)

31659 (JEN-121-DQ/I-36) MECANISMO DE LA ELUCIÓN DEL ERBIO EN UN CAMBIADOR CATIÓNICO CON EL ÁCIDO N-HIDROXIETIL-ETILEN-DIAMONO-TRIACETICO. (The Elution of Erbium from a Cation Exchanger Bed by Means of the N-hydroxyethyl-ethylene-diaminetriacetic Acid). S. Amer Amezaga (Spain. Junta de Energia Nuclear, Madrid). 1963. 73p.

A physicochemical study of the phenomena resulting when erbium is eluted from a cation-exchanger bed at a steady state by N-hydroxyethyl-ethylene-diamine-triacetic acid (HEDTA) is made. Two different retaining beds are used, a hydrogen bed, in which no ammonium passes through, and a zinc bed, which leaks ammonium ion. Good agreement between experimental and calculated values by using the equations deduced for the concentrations of the main species is achieved, with errors around 1–2% in most of the experiments. (auth)

31660 (NP-14005) THE INFLUENCE OF PURGE AIR INTRODUCTION ON THE BEHAVIOUR OF A PULSED, PERFORATED PLATE COLUMN. R. De Witte and L. Geens (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Apr. 1963. 25p. (ETR-159)

The influence of bottom interface detection purge air in a pulse tube column was studied. A marked decrease in amplitude occurred in such a unit when it was membrane-pulsed, but almost no change occurred when it was air-pulsed. The presence of air in an air-pulsed column increased the flooding capacity both in the HNO_3–TBP and in the U–HNO_3–TBP system. Direct air-purged bottom interface detection is thus very useful when combined with air pulsation, but is not so advantageous when membrane pulsation is used. The buildup of crud at the interface was limited to a thin layer, because of the purge air which continuously broke up the layer. (auth)

31661 (NP-14006) EXPERIMENTS CARRIED OUT ON THE EUROCHEMIC TESTING STATION CLIMBING-FILM EVAPORATOR. J. Klitgaard, L. Geens, H. Van Bijlen, and A. Redon (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Jan. 1964. 69p. (ETR-160)

Experiments carried out during the period April 6th, 1960 to October 8th, 1963 on the Eurochemic Testing Station climbing-film evaporator unit are described, and details are given of the unit. It was found that the capacity of the component parts of the unit were not matched. Stable operation was first obtained when 30 out of 43 heat exchanger tubes were plugged. The control system finally selected is as follows: the level is kept constant by an overflow, the feed flow rate is kept constant, the density controls about ¼ of the heating steam flow, and the steam pressure at the reducing valve is manually set according to curves established during the experiments. Overall heat transfer coefficients above 2000 kcal/m^2-hr-°C were found when evaporating uranium solutions with up to 500 g/l uranium. Density measurements in the evaporator caused problems. A description is given of the way in which it was possible to measure density with a relative correction as low as 1 to 3%. Experiments performed on the steam stripping column are also described. The evaporator unit has a decontamination factor of 10^7 for uranium (concentrate to condensate). Kirschbaum's theory of the operation of a climbing-film evaporator is briefly given. (auth)

31662 (ORNL-TM-892) NUCLEAR ENERGY AND SALINE WATER CONVERSION. A BIBLIOGRAPHY (1950–MAY 1964). Helen F. Kuhns, comp. (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 10p.

A bibliography of 105 references on nuclear energy is presented in relation to desalination. Emphasis is on domestic journal and report literature from 1950 through May 1964. (auth)

31663 (UCRL-Trans-1078) THE EXTRACTION OF PLUTONIUM, URANIUM, RUTHENIUM AND ZIRCONIUM BY MEANS OF TRI-ISO-OCTYLAMINE. EXCERPTS. Werner Knoch (Brunswick (City). Technische Hochschule Carolo Wilhelmina). Translated by Senta Pugh (Univ. of California. Lawrence Radiation Lab., Berkeley). 28p.

Investigations were carried out on the extraction of Pu, U, Ru, and Zr from HNO_3 solutions by TIOA, and the results are summarized. Only the mass transfer studies are reported in detail; they were made on U(VI), Pu(IV), and HNO_3 for the transition from HNO_3 solutions into TBP–kerosene and TIOA–xylene. The results agree with film diffusion theory, and mass transfer coefficients were calculated. (D.L.C.)

31664 THE REPROCESSING OF NUCLEAR FUELS, A STEPCHILD OF NUCLEAR TECHNOLOGY? L. Kichler (Farbwerke Hoechst AG, Frankfurt am Main). Atomwirtschaft, 9: 246-51(June 1964). (In German)

The question of where and how irradiated fuel elements should be reprocessed is discussed. The task concerning reprocessing, which is considered most important for the future is the treatment of the fissionable material-breeder material systems: plutonium–uranium and uranium–thorium. Effort is being exerted to develop a cheap, non-aqueous process. There is however still no hope that the aqueous process can be replaced in the near future. The operating experience and the progress already made in the existing aqueous plants and the fact that it has so far not been possible to develop a clearly superior alternative to them encourages the planning of installations based on the aqueous process which, in spite of a relatively small capacity, should attain the same low reprocessing costs as would be predicted for a "hypothetical" large installation. Compact building methods, optimum process control, adaptation to the requirements demanded by the special kind of fuel elements for power reactors, the abandonment of unnecessary flexibility and of a high degree of utilization of the plant are all measures that are appropriate to the reduction of costs. At present a few second-generation reprocessing plants are under construction, which will all utilize the aqueous process. The working out of a scheme for a fuel with 3% enrichment for a reprocessing installation in which fuel elements from MZFR, FR-2, VAK Kahl, and Gundremmingen are to be treated (later also the breeder elements from the Karlsruhe fast breeder) was completed by the Ingenieurgemeinschaft Kernverfahrenstecknik (IGK). The projected site is at Karlsruhe. Features differing essentially from the Eurochemic plant will contribute experience in methods of processing. (auth)

31665 EXTRACTION OF SOME RARE EARTH ELEMENTS BY TRIBUTYLPHOSPHATE IN THE PRESENCE OF AMMONIUM NITRATE. An-chi Yu. Hua Hsueh Hsueh Pao, 29: 443-4(1963).

The distribution ratio between tributylphosphate and aqueous nitric acid (2 to 12 M) at 25°C was determined for Pr, Nd, and Sm nitrates in the presence of 2 to 8 M ammonium nitrate. The salting out effect was found to be marked at low acidities, while the separation was more effective at high acidity. Thus, the highest distribution ratios for Pr and Nd were obtained with 8.0 M ammonium nitrate and 2.0 M nitric acid, while Sm was more effectively extracted by 12.0 M nitric acid. (AID Press)

31666 PAPER CHROMATOGRAPHIC SEPARATION OF BERYLLIUM, ALUMINIUM, CALCIUM AND TITANIUM. D. R. Singh and G. C. Saxena (Agra Univ., India). Indian J. Chem., 2: 251(June 1964).

A paper chromatographic procedure for the separation of beryllium, aluminum, calcium, and titanium from a mixture is described, employing 0.5N ammonium hydroxide for running the chromatogram. The development of the chromatogram is carried out by spraying it with a saturated solution of alizarin in 96% ethanol and then exposing it to ammonia and acetic acid vapors. (auth)

31667 SEPARATION OF THE RARE EARTH ELEMENTS BY ION-EXCHANGE CHROMATOGRAPHY. I. THE USE OF $NH_4^+ - H^+$ DEVELOPMENT COLUMNS. N. E. Topp and D. D. Young (National Chemical Lab., Teddington, Middx., Eng.). J. Chromatog., 14: 469-77(May 1964).

Methods for separating the rare earth elements by ion-exchange chromatography are discussed. The elution of cation-exchange columns, completely loaded with rare earth ions, with complexing agent solutions gave eluates containing cationic and anionic lanthanon. However, if the ion-exchange column was loaded with a controlled $Ln^{3+} - NH_4^+$ mixture, elution gave predominantly an anionic lanthanon complex. Partial separations are obtained under these conditions, and this was shown to be a useful method for the preliminary concentration of complex lanthanon mixtures. Conditions for separating the light earths, using an $NH_4^+ - H^+$ form development column, were established. This method was not successful for separating the heavy earths, and the reasons for this are discussed. (auth)

31668 ION EXCHANGE PROCEDURES. IV. SEPARATION OF ^{234}Th (UX_1) FROM URANYL NITRATE SOLUTIONS. Takeo Murase, Edmund L. Lind, and Frederick Nelson

(Oak Ridge National Lab., Tenn.). J. Chromatog., 14: 478-81(May 1964).

A cation exchange procedure is described for recovering microcurie amounts of carrier-free UX_1 (^{234}Th) from uranyl nitrate solution. Two ion exchange columns are employed, one for initial concentration and the other for final purification. (auth)

31669 THE CHROMATOGRAPHY OF SOME CATIONS ON PAPER IMPREGNATED WITH AMMONIUM PHOSPHOTUNGSTATE. J. Prášilová and F. Šebesta (Faculty of Technical and Nuclear Physics, Prague). J. Chromatog., 14: 550-60(May 1964).

The sorption and separation of ^{86}Rb, ^{134}Cs, ^{89}Sr, and ^{91}Y on paper impregnated with ammonium phosphotungstate ((NH_4PW) is described. Optimum conditions for separation were determined. (M.C.G.)

31670 GLYOXAL-BIS-(2-HYDROXYANIL), A REAGENT FOR PAPER CHROMATOGRAPHIC SEPARATION OF CATIONS. H. G. Moeller and N. Zeller (Universität, Tubingen, Ger.). J. Chromatog., 14: 560-4(May 1964). (In German)

The complexes and the depth of color of the tracks formed by cations with glyoxal-bis-(2-hydroxyanil) (GBHA) were studied at various pH values. Results are presented in tabular form. In order to test the results, a mixture of Ni, Co, Cu, Cd, and Zn ions was separated with good results. (M.C.G.)

31671 PILOT PLANT PROCESSING OF URANIUM–ZIRCONIUM ALLOY NUCLEAR FUELS BY A MOLTEN-SALT FLUORIDE-VOLATILITY METHOD. W. H. Carr (Oak Ridge National Lab., Tenn.). J. Tenn. Acad. Sci., 39: 44-9(Apr. 1964).

Use of the molten-salt fluoride-volatility process for separation of uranium from spent U–Zr alloy fuels is described. The U–Zr alloy fuel elements are dissolved in a molten fluoride solvent with anhydrous hydrogen fluoride. Fluorine is then brought in contact with the melt, volatilizing UF_6 plus some fission product fluorides. The UF_6 is further purified and condensed in a cold trap. The process chemistry is outlined, the pilot plant described, and a flowsheet included. (M.C.G.)

31672 PROCESSING OF URANIUM ORE. A REVIEW OF ESTABLISHED METHODS. J. R. Finniecome. Mech. World Eng. Record, 143: 489-91(Nov. 1963).

Five well-established methods for the processing of uranium ore are described: phosphate precipitation; carbonate precipitation; fixed-bed resin ion exchange; resin-in-slurry exchange; and liquid-liquid solvent extraction. (P.C.H.)

31673 PRODUCTION OF NATURAL URANIUM METAL AND ITS COMPOUNDS FROM PROCESSED ORES. J. R. Finniecome. Mech. World Eng. Record, 144: 145-6(Apr. 1964).

The preparation of natural uranium metal from ore and the intermediate compounds formed are discussed. Preparation of UO_4, UO_3, UO_2, UF_4, and UF_6 is described. (M.C.G.)

31674 PLUTONIUM FROM SWEDISH REACTOR FUEL. Alf Larsson (Aktiebolaget Atomenergi, Stockholm). Tek. Tidskr., 93: 709-13(1963). (In Swedish)

Separation of plutonium from irradiated Swedish reactor fuel is discussed. Fuel enriched up to 1.5% in ^{235}U is treated in a plant with a capacity of 250 kg/day for spent uranium fuel elements. The Zircaloy-2 cladding is dissolved in NH_4F–N[illegible]O_3 solutions. The UO_2 is then dissolved in HNO_3 and treated with TBP in dodecane to separate uranium and plutonium from fission products. Purification is continued so that a purifying factor of 2×10^6 for U and 2×10^8 for Pu is attained. The final products are U_3O_8 and $Pu(NO_3)_4$. The design of the plant, safety and transport problems are discussed. (M.C.G.)

31675 THE KINETICS OF ION-EXCHANGE SORPTION OF ZIRCONIUM AND HAFNIUM BY THE Cu-2 CATIONITE. I. V. Vinarov and A. N. Grinberg (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 359-65(1964).

Kinetics of the ion-exchange sorption of zirconium and hafnium from their oxychloride solutions in dilute nitric acid were studied. The temperature effect on the rate of sorption of Zr and Hf, the effect of temperature on the achievement of ion exchange equilibrium, the effect of mixing on the rate of sorption of Zr and Hf and the effect of mean diameter of cationite particles on the rate of sorption of Zr and Hf were investigated. (OTS)

31676 CUPFERRON SEPARATION OF RARE EARTHS INTO SUBGROUPS. M. A. Tishchenko, R. S. Lauer, and N. D. Poluektov (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Ukr. Khim. Zh., 30: 390-5(1964).

It was established that cupferronates of cerium subgroup elements are readily precipitated by the use of organic solvents while yttrium subgroup elements form more stable solutions. An attempt was made to use this property of cupferronates for separation of rare earths into subgroups. The solubility of rare earth cupferronates in organic solvents, the separation of Ce and Y subgroups by means of isoamyl alcohol and cyclohexanone, and the separation of a mixture of oxides from monoazite and other minerals were studied. (OTS)

31677 SEPARATION OF INORGANIC MIXTURES BY PARTITION BETWEEN TWO LIQUID PHASES. PART 15. ISOLATION OF SINGLE YTTRIUM-EARTHS BY PARTITION OF THEIR THIOCYANATES. Werner Fischer, Karl-Jurgen Bramekamp, Manfred Klinge, and Hans-Peter Pohlmann (Technische Hochschule, Hanover). Z. Anorg. Allgem. Chem., 329: 44-50(May 1964).

Separation of the oxides of rare earth oxides in NH_4SCN-saturated solution was investigated. Partition between water and n-methylpentanone and hexanone, respectively was the technique employed. Yttrium could be separated from the rare earth metals between samarium and lutetium at lower concentrations. The various partition factors for different binary mixtures and the experimental techniques are described. (OTS)

31678 SORPTION OF URANIUM AND THORIUM FROM AMMONIUM THIOCYANATE SOLUTIONS BY EDE-10π ANIONITE. I. A. Kuzin and V. P. Taushkanov. Zh. Prikl. Khim., 37: 764-8(Apr. 1964). (In Russian)

Studies of sorption of U, Zr, Ce, Al, Fe, Ni, Cd, and Ba from ammonium thiocyanate by EDE-10π anionite showed a maximum of uranium sorption in 1 M ammonium thiocyanate solution while Al, Ba, and Ce are not absorbed from the solution. The capacity of EDE-10π anionite for sorption of Zr and Th does not exceed 0.15 m mole/g. (R.V.J.)

31679 SEPARATION OF RARE EARTH MIXTURES BY CONTINUOUS COUNTER-CURRENT ION METHOD. V. I. Gorshkov, L. I. Martynenko, and V. A. Chumakov. Zh. Prikl. Khim., 37: 1183-8(June 1964). (In Russian)

A continuous ion exchange method was used for separating rare earth metals using two countercurrent columns with a continuous frontal separation of the mixture in one column and continuous ion expelling from the exchanger

produced by the first column. Moreover, the solution flowing from the second column is returned to the first column either directly or after certain changes in the content of the mixture. The countercurrent method was used for separation of complex compounds of rare earths with EDTA from the cationite KU-2 with copper and using magnesium complexone for continuous ion expelling from the exchanger. The method proved efficient for separation of rare earths containing 68% Nd, 20% Pr, 7% Sm, and 2% Gd and other elements of the yttrium group. (R.V.J.)

31680 SORPTION OF URANIUM FROM SULFURIC ACID SOLUTIONS BY ANIONS. I. A. Kuzin and V. P. Taushkanov. Zh. Prikl. Khim., 37: 1005-9(May 1964). (In Russian)

Sorption of U, V, Fe, Cu, Al, and Mg from various strength sulfuric acid solutions by AMP, EDE-10P, and AN-2F anion exchange resins was investigated. It was shown that Al and Mg are not sorbed by the resins while copper can be sorbed only by EDE-10P and AN-F. A maximum sorption of uranium by the EDE-10P and AN-2F resins was reached with 0.05M and by AMP resin with 0.025M sulfuric acid solutions. Sorption of Fe, Cu, and V from 0.25 mole/l does not exceed 0.1 mmole/g. The absorption capacities of EDE-10P, AN-2F, and AMP resins for uranium are 223, 198, and 88 mg/g, respectively. (R.V.J.)

31681 CHROMATOGRAPHIC SEPARATION OF THE LANTHANIDE AND ACTINIDE ELEMENTS. (International Atomic Energy Agency, Vienna). 1964. Bibliographical Series No. 11. 127p. STI/PUB/21/11 $2.50; Sch 52.50; 15 s.stg; F.fr.10; DM 8(IAEA).

After a short review of the field, a bibliography of 554 references in abstracted form is presented on the chromatographic separation of actinides and lanthanides by ion exchangers. Subject and author indexes are included. (D.L.C.)

31682 FOAM COLUMN (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1100)

This package contains 3 drawings. For a listing of individual titles, see the Engineering Materials List (TID-4100). This 24 in. foam separation column is used in the countercurrent exchange of solutes between a liquid and the surface of a foam. This method of separation is employed in low-level waste processing. Sight glasses and light ports were fabricated from Plexiglas for the carbon steel column. (M.C.G.)

31683 IMPROVEMENTS IN OR RELATING TO A PROCESS AND APPARATUS FOR THE REACTION OF SOLIDS WITH LIQUIDS. Norman James Keen (to United Kingdom Atomic Energy Authority). British Patent 961,883. June 24, 1964. Filed Mar. 8, 1962.

A process and the equipment for dissolving uranium–zirconium alloys by means of a mixture of hydrofluoric acid and hydrogen peroxide are described. (C.E.S.)

31684 IMPROVEMENTS RELATING TO THE PURIFICATION OF ARGON AND HELIUM GAS. Leslie Arthur John Gardiner (To Western Detail Mfg. Ltd.). British Patent 961,925. June 24, 1964. Filed Apr. 10, 1959.

Equipment for the purification of argon and helium that may be used with glove boxes or controlled-atmosphere furnaces is described. The purification method consists of compression, filtration, impurity removal by gettering agents, and drying. (C.E.S.)

31685 METHOD FOR THE SEPARATION OF URANIUM FROM NEUTRON IRRADIATED ALUMINUM–URANIUM ALLOYS. Raymond Hugh Moore (to U. S. Atomic Energy Commission). German Patent 1,165,873. Mar. 19, 1964. Priority date Apr. 20, 1961, United States.

A method is described for the separation of uranium from neutron-irradiated aluminum–uranium alloys, which contain fission products electronegative and electropositive with respect to aluminum and also plutonium. The alloy is dissolved in a molten aluminum halide–alkali halide mixture and the uranium halides obtained are reduced with aluminum. It was found that it is advantageous to use a critical quantity of aluminum halide instead of equimolecular quantities of alkali halide and aluminum halide. The molar ratio of the aluminum ions to the alkali ions may range from 0.1 to 0.5. (Gmelin Inst.)

31686 THE SEPARATION OF CALIFORNIUM FROM CURIUM BY SOLVENT EXTRACTION. Donald Francis Peppard and George Webster Mason (to U. S. Atomic Energy Commission). German Patent 1,166,166. Mar. 26, 1964. Priority date July 20, 1960, United States.

The separation of trivalent californium from trivalent curium when both are present in a watery, muriatic solution is described. The acidity of the watery solution is adjusted between 0.01 and 1 mol, and brought together with a solution of 2-ethylhexylhydrogenmonochlormethylphosphonate or 2-ethylhexylhydrogenphenylphosphonate in an aromatic hydrocarbon or in carbon tetrachloride. The trivalent californium passes over into the organic phase while the trivalent curium remains in the watery phase. Then the organic phase is separated from the watery phase. (Gmelin Inst)

ENGINEERING

General

31687 (LADC-6458) EXPLOSIVE SIMULATION OF NUCLEAR BLAST ON TEST VEHICLES. W. E. Deal and J. W. Taylor (Los Alamos Scientific Lab., N. Mex.). May 29, 1964. Contract [W-7405-eng-36]. 21p. (CONF-592-1)

Two explosives techniques have been adapted and developed for blast vulnerability studies on very hard vehicle designs. The first employs a large, expendable, explosive-driven shock tube; the second a sheet explosive overlayer with an intervening pulse-shaping medium. (auth)

Applications of Nuclear Explosions

31688 (A/CONF.28/P/291) ENGINEERING APPLICATIONS OF NUCLEAR EXPLOSIVES— PROJECT PLOWSHARE. Gerald W. Johnson (California. Univ., Livermore. Lawrence Radiation Lab.) and Gary H. Higgins. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Experience obtained in the Plowshare program is reported. Principal activities have been devoted to developing understanding of basic processes of nuclear detonations in a variety of environments, development and test of explosives especially designed for the program, assessment of safety and cost, conducting field experiments with chemical and nuclear explosives, consideration of legal and diplomatic procedures to allow use of perfected techniques. Most of the experience was obtained from non-Plowshare detonations conducted by the U. S. in the past 19 years. (T.R.H.)

31689 (NP-14063) INVESTIGATION OF THE FEASIBILITY OF MANUFACTURING AGGREGATE BY NUCLEAR METHODS. R. L. Curry (Waterways Experiment Station, Vicksburg, Miss.). Apr. 1964. 45p. (MP-6-643)

Preshot and postshot samples of basalt from the Danny Boy crater area were tested for physical properties to determine feasibility of nuclear manufacturing of aggregate for construction purposes. It was established that for this event at least 20 percent of the as-is ejecta could be useful as concrete aggregate with only sieving, and that with a small amount of secondary crushing more could be made available. Based on this limited study, further studies of other nuclear events in various types of rock are recommended. (auth)

31690 (UCRL-7850) ECONOMICS OF GROUND WATER RECHARGE BY NUCLEAR AND CONVENTIONAL MEANS. David K. Todd (California. Univ., Berkeley). Feb. 1964. For Univ. of California, Lawrence Radiation Lab., Livermore. Contract W-7405-eng-48. 131p.

The Plowshare Program has been established to give technical direction and guidance to engineering applications of nuclear explosions. Massive excavation by explosions has been shown to cost between $0.03 and $5.00 per cubic yard, depending upon the size of the project. With the possible savings indicated, it is logical to consider the use of nuclear explosives in the development of water resources, where a capital expenditure of about $10 billion annually is involved, including earth and rock movement in the United States, alone. A comparison is made of the economics of a conventional earth-fill dam, reservoir, and spreading basins with a nuclear cratering project producing an equivalent storage volume. The comparison indicates that the costs are about equal for projects developing 6000 acre-feet of storage. The nuclear cratering method offers an economic advantage for projects developing more than 6000 acre-feet of storage and in areas involving high land costs. (auth)

Facilities and Equipment

Refer also to abstracts 31995 and 32275.

31691 (BLG-232) EENVOUDIGE AUTOMATISCHE TOEPLER-POMP MET INGEBOUWD GASMEETSYSTEEM. (Automatic Toepler Pump for Collection and Measurement of Gas Systems). R. Gilissen, P. de Meester, and A. J. Flipot (Centre d'Étude l'Énergie Nucléaire, Brussels). Nov. 1963. 14p.

A description is given of an automatic Toepler pump for collection and measurement of gas quantities. The pump, the construction of which is simple and inexpensive, has proven to be reliable and easy to manipulate, while the measuring sensitivity relative to other systems is increased. For collection and measurement of the gas, only one mercury reservoir is required; many difficulties inherent in other types are thus avoided. The simultaneous measurement of volume and pressure, as well as the calculation of the amount of gas, is given. (auth)

31692 (GAT-432) STRESSES IN DIE-CAST ALUMINUM AXIAL FLOW COMPRESSOR BLADES. C. O. Langebrake (Goodyear Atomic Corp., Piketon, Ohio). May 4, 1964. Contract AT(33-2)-1. 22p.

Studies have been made on the stresses developed in die cast aluminum blades in an axial flow compressor operating in an environment of uranium hexafluoride. Tests were conducted both in a test loop and in a production area (cascade). Sixteen stator blades and one rotor blade in the test compressor were equipped with strain gages. The data showed that all stator blades had sufficient strength for normal operation although considerably above normal blade stresses occurred during start-up and surging of the compressor under load. Severe blade stresses were encountered during shut-down of the compressor under load. These stresses were greatly reduced by decreasing the operating pressure (load). One row of stator blades appears to be stressed excessively during surging and during shutdown under load. No evidence of excessive blade stresses due to rotating stall was observed. One method of damping blades was tried but was unsuccessful. Accelerometer data obtained from outside the compressor during the tests could be correlated with stress fluctuations occurring in the various blade rows. Further study of this method of determining relative blade stresses in an operating compressor is planned. The signal obtained from the only strain gage used on a rotor blade was too weak to allow accurate stresses in this blade to be determined. (auth)

31693 (MATT-264) AN INDUCTIVE ENERGY STORAGE SYSTEM USING IGNITRON SWITCHING. E. Simon and G. Bronner (Princeton Univ., N. J. Plasma Physics

Lab.). Apr. 1964. Contract AT(30-1)-1283. 33p. (CONF-542-4)

From 5th Symposium of the Engineering Aspects of Magnetohydrodynamics, Cambridge, Mass., Apr. 1964.

Previous work in the field of inductive energy storage and control is described. The need for a fast, reliable switch for the control of such systems is pointed out. A new inductive energy storage switching system that fulfills this need is described. The new system utilizes an ignitron bridge circuit and a capacitor to invert from the unidirectional current of an inductive source to an alternating voltage of triangular waveform. The alternating voltage is used to charge and periodically recharge a small capacitor. This capacitor in its turn supplies energy to the load. Thus, by the use of two capacitors, whose maximum stored energy is very small compared to the total energy to be transferred, the stored energy may be transferred to the load in discrete parcels. The disassociation of storage and load circuit allows the transfer of all stored energy to the load, with the exception of the usual resistive energy loss imparted by circuit elements, a quantity which can be kept small. Therefore, the energy efficiency is higher than heretofore attained by inductive energy storage systems. The switching system does not depend upon moving contacts or mechanical devices. The system results in significant reductions in initial cost per joule of energy stored. The bridge inverter may also be used to store the energy in the storage inductor by using it as a rectifier. This eliminates the need for a costly d-c supply. The inherent low energy efficiency of earlier inductive energy storage systems is discussed and it is pointed out that the theoretical energy efficiency of the bridge scheme is much higher. Current relations in the circuit during charge and during transfer are described. Initial costs of a given system are developed from the circuit parameters. A small-scale prototype was constructed and operated successfully; oscillograms of currents and voltages are shown. Optimization of circuit parameters is discussed. (auth)

31694 (NLCO-901) PILOT PLANT PRODUCTION OF URANIUM TETRAFLUORIDE BY THE WINLO AQUEOUS PRECIPITATION PROCESS. Stephen Cseplo and Carl C. Fogel (National Lead Co. of Ohio, Cincinnati). June 25, 1964. Contract AT(30-1)-1156. 37p.

Pilot-scale equipment was developed for the production of metal-grade uranium tetrafluoride (green salt) by the Winlo aqueous reduction-precipitation process. The green salt was made in Pilot Plant 100-, 200-, and 1000-gallon precipitation units. Semihard rubber tank linings and Saran-lined piping favorably withstood contact with the corrosive Winlo solutions (HF, H_2SO_4, HNO_3, HCl). Impervious-graphite immersion heaters and a steam-heated, stainless steel dryer for drying the green salt worked well and did not deteriorate excessively. Uranyl nitrate solutions, which could not be used directly in the Winlo process, were continuously converted to uranyl chloride solutions on a large scale by reaction with HCl and formaldehyde in a heated, flow-through glass reactor. (auth)

31695 (TID-19277) MAGNETIC STIRRER FOR A CLOSED DIFFUSION CELL. L. H. Cook, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Aug. 1963]. Contract AT(07-2)-1. 4p.

A magnetic stirrer was designed for stirring solutions in a closed diffusion cell immersed in a constant-temperature bath. The device uses an external rotating magnetic field to rotate small permanent magnets inside the cell. The rotating magnetic field is created by an annular assembly of eight electromagnets which are energized in sequence. (D.L.C.)

31696 (TID-20846) AN OUTLINE OF A METHOD FOR THE INVESTIGATION OF THE STABILITY OF GAS-LUBRICATED TILTING-PAD JOURNAL BEARINGS. Interim Report. E. J. Gunter, Jr., and V. Castelli (Franklin Inst. Labs. for Research and Development, Philadelphia). Apr. 1964. Contract Nonr-2342(00) (FBM) (C). 52p. (I-A2049-21)

Tilting-pad journal bearings are extremely stable under ordinary conditions, but under certain extreme conditions they may develop some form of self-induced instability. A method is described for the analysis of the stability of this type of bearing based on the small perturbation technique. Discussed in detail are the choice of coordinates, the geometry of the bearing, and the kinematics of the bearing. (auth)

31697 (TID-20847) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED, TURBOMACHINERY. Quarterly Technical Report, December 1, 1963–February 29, 1964. J. C. Hinkle, E. J. Gunter, Jr., and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 22p. (Q-A2392-3-12)

Effort is applied to the design and analysis of both self-acting and externally-pressured gas-lubricated bearings. The following steady-state characteristics of the self-acting, pivoted-pad, gas-lubricated bearing are analyzed: hydrodynamic fluid friction in the bearing shoes, maximum load-carrying capacity of bearing shoes for $\Lambda = \infty$, optimum shoe clearance for various operating speeds, optimum design Λ, and influence of ambient pressure. (auth)

31698 NEW PRINCIPLES IN HOT CELL CONSTRUCTION. G. Siewert. Kernenergie, 7: 333-5(May 1964). (In German)

The body of the new hot cell described is a cylindrical container and constitutes a separate module. A prototype was constructed that had a 2000-millimeter diameter. The cell is equipped with suitable entry doors, ventilation systems, separate openings for containers, and working surfaces. Provisions for suitable types of internal illumination were incorporated in the design. The working bench can be replaced easily; it is mounted on casters and can be rolled out. Total weight is 1.3 [metric] tons. A special pedestal, capable of being leveled as desired, was constructed to hole the hot cell. The cell can be evacuated heated, cooled, and/or filled with any gas. While the cell described is located horizontally, one may also be developed for vertical location. (OTS)

31699 USE OF SILVER CHLORIDE SEALS FOR CESIUM VAPOR DEVICES. A. L. Eichenbaum, F. H. Norman, and H. Sobol (Radio Corp. of America, Princeton, N. J.). Rev. Sci. Instr., 35: 1056-7(Aug. 1964).

The utility of AgCl seals for devices employing cesium vapor at pressures up to 0.1 mm Hg was studied. Mass spectroscopi studies revealed that AgCl reacts with hot Cs vapor. The reaction rate is, however, sufficiently slow to permit long-life seals in cesiated tubes. A cesiated tube using an AgCl seal was operated over an extended period without any signs of seal damage. (auth)

31700 MEGAMPERE, HIGH VACUUM, LOW INDUCTANCE CURRENT FEEDTHROUGH. R. S. Lowder and R. W. Waniek (Advanced Kinetics, Inc., Costa Mesa, Calif.). Rev. Sci. Instr., 35: 1070-1(Aug. 1964).

A feedthrough which has coaxial geometry with cylindrical symmetry was developed for supplying a high-current capacitor pulse to a low-inductance load in a vacuum cham-

ber. The unit has withstood 3000 discharges at 0.4 Mamp and 10 kv without any measurable vacuum loss or voltage breakdown. (D.C.W.)

31701 A STUDY OF THE PUMPING MECHANISM OF A GETTER ION PUMP BY A TRACER TECHNIQUE. [PART] I. K. Kawasaki. Shinku, 5: 230-41(June 1962). (In Japanese)

The stabilization of the spontaneous periodic pressure fluctuation for an inert gas, e.g., Ar in a diode-type getter ion pump, can be improved by using a modified triode-type getter. Assuming that the behavior of Ar was the same as that of Xe, the pumping mechanism was studied by means of ^{131m}Xe ($t_{\frac{1}{2}}$ = 12 days) obtained from the disintegration of ^{131}I ($t_{\frac{1}{2}}$ = 8.06 days). The tracer gas was absorbed by a getter ion pump electrode. The active distribution on the surfaces was measured by a G-M counter and radiography. The ion pump was operated at 2 to 8×10^{-4} torr for 5 min to 3.5 hr. In the diode type, only the inside surface of cathode was spattered and eroded, but no erosion was found on the anode or on the glass wall. In the triode type, Xe gas was captured on the surfaces of the cathode, ion collector, anode, and glass wall. (OID)

31702 DRY BOX SYSTEM FOR MASS SPECTROMETER (Engineering Materials). (Dow Chemical Co., Denver, Colo.). (CAPE-1112)

Thirteen drawings are included. For a listing of individual titles, see the Engineering Materials List (TID-4100). The dry box system is located in a laboratory 180 ft long and 19 ft wide. It contains the mass spectrometer box, two 4 ft wide balance hoods, an 8 ft long fume hood, an arc dry box, conveyor dry boxes, and 4 chemical dry boxes. The mass spectrometer box is fabricated of strip, bar rolled 304 stainless steel plate 27½ in. × 40 in. × 23 in. high. There is a ½-in. thick Plexiglas viewing window 34 in. × 13¼ in. Two 8 in. in dia. glove ports are located in the front of the boxes. The arc stand dry box is fabricated of 18.8 stainless steel and is 3 ft × 2 ft 9 in. × 3 ft 3 in. high. The box also has two 8 in. glove ports and a ¼ in. thick safety glass window 13½ in. × 25½ in. The conveyor boxes are 6 ft × 2 ft 6 in. × 3 ft high. The end panels have a 21⅞ in. dia. opening. (P.C.H.)

31703 PNEUMATIC FILTER PAPER PRESS (Engineering Materials). (Union Carbide Corp., Y-12 Plant, Oak Ridge, Tenn.). (CAPE-1114)

One drawing is included. For a listing of individual titles, see the Engineering Materials List (TID-4100). The press is used to pelletize 1¼ in. dia. filter paper, used to collect industrial hygiene air and beryllium oxide samples, so that the pellets may be loaded into the crater of a graphite spectrographic electrode. A piece of paper 1¼ in. dia. is folded in the middle to form a semi-circle with the sample side inside. The paper is then inserted into the slot of a steel wire so that the wire approximately bisects the paper. The wire is rotated so that the filter paper is rolled into a cylinder. The cylinder of paper is inserted into the pelletizing chamber and the wire is withdrawn. The chamber door is closed and air pressure is applied. The pressure is released and the pellet is removed and placed in the crater of the electrode. The electrode is placed with the other electrodes in an Al electrode block and put in a muffle furnace to char the paper to an ash. The electrode is then ready to arc in a spectrograph. (P.C.H.)

31704 IMPROVEMENTS IN FLUID PRESSURE RESISTANT COUPLINGS AND CLOSURES FOR OPENINGS. Joseph Robinson (to Bristol Aerojet Ltd.). British Patent 961,414. June 24, 1964. Filed Aug. 29, 1961.

A seal for the opening in a vessel that has a higher fluid pressure within it than immediately outside it is described. The locking members of the seal co-operate with the tapered peripheral surface on the body and are caused to move radially outward from a retracted position at which they may pass through the mouth of the opening to an extended position at which they engage the shoulder in the opening. (C.E.S.)

31705 REMOTELY CONTROLLED MACHINE TOOL. (to European Atomic Energy Community (EURATOM). British Patent 962,037. June 24, 1964. Priority date July 25, 1961, Belgium.

A remote-control machine tool for severing the tops and ends or the weld seams of fuel rods or specimen tubes is described. (C.E.S.)

31706 IMPROVEMENTS IN PRESSURE-GENERATING LIQUID SURGE RESERVOIRS ADAPTED FOR USE WITH OR IN COMMUNICATION WITH SYSTEMS OPERATING WITH FLUID UNDER PRESSURE. (to Babcock & Wilcox Co.). British Patent 962,655. July 1, 1964. Priority date Sept. 10, 1959, United States.

A description is given of a pressure-generating liquid surge reservoir comprising a pressure vessel and liquid heating means exterior to the pressure vessel. It is adapted in communication with heat transfer, chemical processing, or other systems to apply requisite water pressure while permitting volume changes of the circulating water. (L.B.S.)

31707 IMPROVEMENTS IN OR RELATING TO PLUGS FOR PIPES AND LOCKING MEANS THEREFOR. Terance Edward Gouvenot Gardiner, John Rodney Dyson Fuller, Eric Sidney Ager, and David James Plumley Wilkins (to Bristol Aerojet Ltd.). British Patent 963,057. July 8, 1964. Filed May 4, 1959.

Seals for use between two members which are linearly movable relative to one another, and in which the connecting structures comprise a sleeve, a tubular member within a sleeve, a ring member outside the sleeve, and at least one connecting member between the ring member and the tubular member, are described. (L.B.S.)

31708 IMPROVEMENTS IN OR RELATING TO PLUGS FOR PIPES AND LOCKING MEANS THEREFOR. Mervyn Reginald John Broomfield (to Bristol Aerojet Ltd.). British Patent 963,198. July 8, 1964. Filed May 4, 1959.

The combination of a plug for sealing a valve orifice, and means capable of locking and releasing it from a pipe portion formed internally with a peripheral groove and with a valve seat are designed. (L.B.S.)

31709 IMPROVEMENTS RELATING TO GAS PRESSURE CONTROLLED RELIEF VALVE DEVICES. Alan Ainsworth (to United Kingdom Atomic Energy Authority). British Patent 963,208. July 8, 1964. Filed Sept. 18, 1961.

A pressure relief valve device is designed for a glove box in which for example, an inert gas such as argon is to be maintained at some specified slightly sub-atmospheric pressure. The device comprises a first conduit formed as a casing and a second conduit as a dip tube penetrating the casing and projecting at an end into an open-topped receptacle which acts as the liquid holding means and is disposed together with the first receptacle inside the casing. (L.B.S.)

31710 A FLUID FLOW CONTROL VALVE ACTUATED BY PRESSURE WAVES. (to Sulzer Freres Societe Anonyme). British Patent 963,411. July 8, 1964. Priority date July 7, 1961, Switzerland.

A fluid flow control valve in which a valve plate is suspended from springs and is supported by a valve seat constructed as a grating when the valve is closed is designed

to protect a ventilating system from explosion pressure waves. (L.B.S.)

31711 HOT TRAP FOR THE REMOVAL OF HYDROGEN IMPURITY FROM ALKALI METALS. Richard Alexander Hamilton Pool and Vivian Milby Sinclair (to United Kingdom Atomic Energy Authority). British Patent 963,548. July 8, 1964. Filed Oct. 10, 1961.

A hot trap in which the metal getter has a metallic coating over its exposed surfaces which, in operation, is hydrogen-permeable and compatible with low melting point alkali metals is designed. An example using zirconium as the metal getter is given. (L.B.S.)

31712 REMOTE-CONTROL MASTER-SLAVE MANIPULATOR. Alan Ainsworth (to United Kingdom Atomic Energy Authority). British Patent 963,552. July 8, 1964. Filed May 7, 1962.

A remote-control master-slave manipulator is designed which replaces the flexible tapes or wires extending along the arms and beam or electronic means for interconnecting the handgrip and the handler with rotatable connecting rods extending axially along the arms and beam and epicyclic gears for compensating rotary movement to the connecting rods when arm movements relative to the rods are made. (L.B.S.)

31713 REMOTE-CONTROL MASTER-SLAVE MANIPULATOR. Alan Ainsworth (to United Kingdom Atomic Energy Authority). British Patent 963,553. July 8, 1964. Filed May 7, 1962.

A description of a remote-control master-slave manipulator with telescopic rotary connecting rods extending axially of the beam between the shoulder joints for interconnecting the handgrip and the handler is given. (L.B.S.)

31714 APPARATUS FOR EVAPORATION AND DRYING OF RADIOACTIVE SAMPLES. Charles Christianson and Ralph C. Maggio (to U. S. Navy). U. S. Patent 3,139,370. June 30, 1964. Filed May 9, 1961.

A high-speed evaporation for 2-cc samples of aqueous coolant is described that enables periodic monitoring of radioactivity in the reactor coolant. A 250-w infrared lamp is used as the heat source. (R.E.U.)

Heat Transfer and Fluid Flow

31715 (A/CONF.28/P/225) LIQUID-METAL HEAT TRANSFER. Orrington E. Dwyer (Brookhaven National Lab., Upton, N. Y.) and Richard N. Lyon. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Heat transfer equations, developed for liquid metals, involve the eddy diffusivity of moment transfer ϵ_M and the ratio ψ of the eddy diffusivities of heat and momentum transfer. The determination of ϵ_M and ψ and their effects on Nusselt number are discussed. Theory is compared with experiment for channel flow. The calculation of heat transfer coefficients for cross flow through rod bundles and tube banks is considered. Geometrical asymmetry effects on heat transfer rates are discussed. Finally, boiling liquid-metal heat transfer is discussed briefly. (D.L.C.)

31716 (A/CONF.28/P/231) HELICAL, FORCED-FLOW HEAT TRANSFER AND FLUID DYNAMICS IN SINGLE AND TWO-PHASE SYSTEMS. H. F. Poppendiek (Geoscience Ltd., Solana Beach, Calif.), W. R. Gambill, and N. D. Greene. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The influence of superposed, rotational motion on forced-flow heat transfer and fluid dynamics in single- and two-phase systems is discussed. Data are given and analytical interpretations are discussed for heat and momentum transport characteristics. Applications of helical-flow cooling in gas- and liquid-cooled reactors and heat exchangers are suggested. (R.E.U.)

31717 (CONF-595-1) BURNOUT IN NET QUALITY BY LIQUID FILM DESTRUCTION. James B. Carr (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 2, 1964. Contract W-31-109-eng-52. 12p.

From AICHE (NENY) Symposium in Miniature, Latham, N. Y., Mar. 1964.

A similarity criterion suggested by Zuber for prediction of film destruction in two-phase flow is shown to correlate DNB data from British and Italian laboratories in the region of small heat flux dependence. The criterion may be approximated by: $(G \times \nu_L/g\sigma)\sqrt{\rho_L/\rho_g} = (\text{const.})[(G(1-x)\,De/\mu_L)]^n$. The criterion may be used to estimate the upper limit of DNB quality. (auth)

31718 (EURAEC-930) A DEVICE FOR THE MEASUREMENT OF SHEAR STRESS ON THE WALL OF A CONDUIT — ITS APPLICATION IN THE MEAN DENSITY DETERMINATION IN TWO-PHASE FLOW — SHEAR STRESS DATA IN TWO-PHASE ADIABATIC VERTICAL FLOW. Topical Report No. 10. L. Cravarolo, A. Giorgini, A. Hassid, and E. Pedrocchi (Centro Informazioni Studi Esperienze, Milan). Feb. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 121p. (CISE-R-82)

This report describes a new instrument for the measurement of shear stress on the wall and, moreover, for the determination of the mean density (hence of the overall slip ratio and liquid volume fraction) of two-phase mixtures in adiabatic vertical flow. An error analysis of the investigated quantities is presented and the consequent design criteria are discussed. Systematic experiments were carried out under the following conditions:

Flow:	vertical upward (under various flow patterns)
Geometry:	round conduit, 25 mm ID
Fluids:	gas phase: argon liquid phase: water and ethyl alcohol
Flow rate:	20 + 250 g/cm^2-sec
Mass quality:	0.01 + 0.85
Temperature:	18 + 20°C
Pressure:	up to ~22 kg/cm^2

Only the shear stress data are presented and discussed. (auth)

31719 (GEAP-4592) THE EFFECTS OF NON-UNIFORM FLOW AND CONCENTRATION DISTRIBUTIONS AND THE EFFECT OF THE LOCAL RELATIVE VELOCITY ON THE AVERAGE VOLUMETRIC CONCENTRATION IN TWO-PHASE FLOW. N. Zuber and J. A. Findlay (General Electric Co., Schenectady, N. Y.). Apr. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 77p. (EURAEC-1096)

A general expression which can be used either for predicting the average volumetric concentration or for analyzing and interpreting experimental data is derived. The analysis takes into account both the effect of non-uniform flow and concentration profiles as well as the effect of the local relative velocity between the phases. The first effect is taken into account by a distribution parameter, whereas the latter is accounted for by the weighted average drift

velocity. The results predicted by the analysis are compared with experimental data obtained for various two-phase flow regimes, with various liquids over a wide pressure range. Good agreement with experimental data is shown. (auth)

31720 (ILL-13-P) GAS-SOLID FLOW. S. L. Soo (Illinois. Univ., Urbana). May 1964. Project SQUID. Contracts Nonr-3623(00) and NR-098-038. 83p. (CONF-602-1)

From the Symposium on Single- and Multi-Component Flow Processes, New Brunswick, N. J., May 1964.

Studies concern basic aspects of gas-solid suspensions: (1) Thermodynamic properties of a gas-solid system, additional irreversibility in momentum transfer, and the meaning of total pressure; (2) consideration of rigorous solution of problems of gas-solid flow and application of momentum integral method to laminar boundary layer motion to determine the velocity and concentration distribution of the solid phase with correlation in terms of a "gas-solid momentum number," N_m; (3) effect of electric charges on flow over a solid wall and correlation in terms of electric Reynolds number and a new "electro-viscous number," N_{ev}; and (4) effect of solid particles on mixing length of turbulence. (auth)

31721 (IS-830) RADIAL VARIATION OF EDDY DIFFUSIVITY TENSOR COMPONENTS FOR THREE-DIMENSIONAL MASS TRANSPORT. Alvin Eugene Konopik and Ray Fahien (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 125p.

Eddy diffusivities and 90 percent confidence limits for mass transport as a function of radial position and Reynolds number were determined for turbulent flow of water in a pipe. The experimental data were obtained in a 4-inch copper pipe with two salt injection tubes placed diametrically at the wall of the pipe. The salt concentrations as functions of angular and radial position were obtained by an electrical conductivity method and time-averaged utilizing an analog computer. An IBM 7074 digital computer was utilized in the calculation of the diffusivities from the concentration profiles. The radial diffusivity results agree with previous mass transfer studies in which the direction of transport was toward the wall. This provides strong evidence that the eddy diffusivity tensory components are independent of concentration gradients. An adequate description of the turbulent mass transport process was obtained by considering only the radial and angular diffusivity tensor components. In this investigation, a significantly more detailed description of the mass transport process was not obtained by the addition of any individual nondiagonal element of the diffusivity tensor or axial diffusivity to justify the additional time or complexity caused by a three-parameter turbulent diffusion equation. The importance or significance of a diffusivity tensor component was based upon its contribution to the diffusion equation rather than the magnitude of the component. The values of angular and radial mass diffusivities are of the same order of magnitude but vary considerably with radial position. In general the mass diffusivities were larger than the literature values of momentum diffusivities. Near the wall the angular diffusivity component was greater than the radial diffusivity component for all Reynolds numbers (5,000, 10,000, and 20,000) of this investigation. (auth)

31722 (MTI-64TR-25) THE STABILITY OF FLOW BETWEEN CONCENTRIC CYLINDRICAL SURFACES WITH A CIRCULAR MAGNETIC FIELD. R. C. DiPrima and C. H. T. Pan (Mechanical Technology Inc., Latham, N. Y.). May 1964. Contract Nonr-3731(00)(FBM). 20p. (AD-601487)

The stability of a viscous, electrically conducting fluid confined between two infinitely long concentric cylinders, which are either rotating (the Taylor problem) or for which there is a circumferential pressure gradient (the Dean problem) in the presence of a circular magnetic field, has been the subject of a number of previous investigations. The similar problem for a rotating, inviscid, perfectly conducting fluid with a current along the axis was considered by Michael. More recently, the Taylor problem for a non-Newtonian fluid with a circular magnetic field was considered by Narasimham. The mathematical formulation of the stability problem leads to a number of special cases, depending upon whether the walls of the containing cylinders are conductors or nonconductors relative to the fluid; and for the Taylor problem depending upon whether the cylinders are rotating in the same or opposite directions. The known results are summarized for the purpose of clarity and completeness. Also, new results for the Dean problem with conducting walls and with nonconducting walls are given. The computations indicate that the eigenvalue problem can be solved satisfactorily by using the Galerkin method with simple sets of polynomials for the expansion functions. All of the previous theoretical investigations, as well as the present one, are limited to the small-gap case, where it is assumed that the gap between the cylinders is small compared to the mean radius. (auth)

31723 (NP-14072) KRITICHESKIE TEPLOVYE POTOKI PRI VYNUZHDENNOM TECHENII VODY. (Critical Heat Flux During the Forced Flow of Water). G. V. Alekseev, B. A. Zenkevich, O. L. Peskov, O. V. Remizov, N. D. Sergeev, and V. I. Subbotin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 22p.

Data on subcooled water and steam-water mixtures in tubes were compared for the following configurations: one tube in a radially symmetric channel, square channel tubes, and tube bundles (external longitudinal flux). (R.V.J.)

31724 (ORNL-P-35) STUDIES IN BOILING WITH LIQUID POTASSIUM. H. W. Hoffman and A. I. Krakoviak (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 16p. (CONF-537-2).

From the USAEC-EURATOM Conference on Two Phase Flow Problems, Washington, D. C., Apr.-May 1964.

Some experiments involving convective boiling with K in tubes are described. These experiments include forced-convection burnout in a medium flux level boiler (~100,000 Btu/hr-ft^2) and superheat in a natural convection loop. Temperature oscillations were observed in the superheat experiments, and a periodic mechanism is proposed in which bubbles are formed in a highly superheated environment. (D.L.C.)

31725 (SAN-409-5) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Quarterly Technical Report, March 1-May 31, 1964. H. F. Poppendiek, N. D. Greene, C. M. Sabin, R. K. Livett, F. R. MacDonald, and L. V. Feigenbutz (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 30p. (GLR-25)

The initial potassium heat transfer research consisting of forced-flow boiling and droplet vaporization is discussed. The characteristics of the forced-flow boiling system are outlined and preliminary experimental results for potassium droplet vaporization are discussed. Forced-flow boiling mercury measurements obtained in the radiantly

heated boiler system are reported and interpreted. These results, which correspond to parameter regions different from those obtained in the Haynes 25 alloy system, are compared with the earlier work. The two sets of measurements are in general agreement with each other and with asymptotic theoretical relations. An analysis is made of low vapor quality forced-flow sodium boiling heat transfer data reported in the literature; these data are compared with predicted values based on the postulate that liquid films exist contiguous to the boiler tube wall. A significant difference between predicted and experimental values is found. The thermodynamic properties of potassium vapor in the superheat region are calculated; specifically, vapor pressure, enthalpy, specific heat, and equilibrium compositions of diatomic and monotomic potassium are presented. (auth)

31726 (TID-20286) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 8, December 1963. (Babcock and Wilcox Co., Barberton, Ohio). Contract AT(11-1)-1280. 58p.

Design and development work for the full-size steam generators, reheater, integral reheater-steam generator, and 30-Mw(t) prototype steam generator are described. Progress is summarized for the corrosion studies in a sodium-heated boiler test loop, heat transfer studies in a boiler, and corrosion studies of Croloy 2¼ steel in NaOH solutions. The welding of tubes to the tube sheets and the radiographic inspection of the welds are discussed. EDTA and sulfamic acid are being evaluated for leaching out of oxide inclusions in Croloy 2¼ and type 316 stainless steel. The critical path schedule of the research program is described. (D.L.C.)

31727 (TID-20601) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 7, November 1963. (Babcock and Wilcox Co., Barberton, Ohio). Contract AT(11-1)-1280. 60p.

The design and development of the full-size steam generator and reheater are described. A feasibility study is in progress of an integral reheater steam generator design. The design of the 30-Mw(t) prototype steam generator is also described. A sodium-heated boiler test loop will be constructed for corrosion studies. A helical test section has been fabricated for the heat transfer apparatus. Progress of the tests on the corrosion of Croloy 2¼ steel in NaOH solutions is reported. Welding of tubes to the back side of the tube sheet and the radiographic inspection of the welds are discussed. Tests will be made on the ability of EDTA and sulfamic acid to leach out oxide inclusions in Croloy 2¼ and type 316 stainless steel. Finally, the critical path schedule of the research program is discussed. (D.L.C.)

31728 (TID-20602) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 10, February 1964. (Babcock and Wilcox Co., Barberton, Ohio). Contract AT(11-1)-1280. 72p.

Design criteria for the design of a sodium-heated once-through steam generator are outlined. Present statuses are given of the development of the full-size steam generators, reheater, integral reheater-steam generator, and 30-Mw(t) prototype steam generator. Progress is also summarized briefly for the corrosion and heat transfer studies, welding of tube-to-tube sheet and radiographic inspection of the welds, and leaching-out of oxide inclusions in steels. A program for engineering analysis of the sodium-water reaction is described. The critical path schedule of the research program is discussed. (D.L.C.)

31729 (TID-20724) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 12, April 1964. (Babcock and Wilcox Co., Barberton, Ohio). Contract AT(11-1)-1280. 70p.

Design criteria for the design of a sodium-heated once-through steam generator are outlined. The development of the full-size generators, reheater, integral reheater-generator, and prototype generator is summarized. Some results are given of the operation of the sodium-heated boiler test loop and the heat transfer apparatus. Progress is reported on the corrosion of Croloy 2¼ steel in sodium-water reaction products, welding of tube-to-tube sheet and radiography of the welds, and leaching-out of oxide inclusions in steels. A program to be initiated on the sodium-water reaction is described. The critical path schedule of the research program is described. (D.L.C.)

31730 (TID-20789) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Bimonthly Progress Report for Months of March–April 1964. B. Matzner (Columbia Univ., New York. Engineering Research Labs.). Apr. 30, 1964. Contract AT(30-3)-187. 9p. (BPR-XIII-3/4-64)

The high pressure loop was utilized for burnout testing of three different long internally cooled tubes (uniform heat flux, cosine heat flux, and uniform heat flux with a swirl promoter). The results will be issued in a separate report. Technical details of a new method of controlling the Columbia 3.5 Mw motor-generator set are presented. The new system is extremely easy to use and very sensitive. (auth)

31731 (UCRL-6787) EFFECT OF "ROUGHER THAN ROUGH" SURFACES ON MOLECULAR FLOW THROUGH SHORT DUCTS. Donald H. Davis, Leonard L. Levenson, and Norman Milleron (California. Univ., Livermore. Lawrence Radiation Lab.). July 10, 1963. Contract W-7405-eng-48. 15p.

Gaede reported lower molecular flow rates through some tubes than expected if he assumed the walls were 100 percent diffuse reflecting. He conjectured that back reflection from surface asperities might be responsible. Gaede's intuitive guess is supported by measurements of flow rates and applications of the Monte Carlo calculational method to geometrical models. The results show that: (1) surface finishes from ½ to 64 microinches roughness yield flow rates from 5 percent above to 6 percent below the diffuse wall prediction; (2) specular reflection can account for the 5 percent higher value; (3) for cylinders with internal corrugations, fins, and threads of groove depth from 0.1 to 15 percent of the minimum tube radius and included angle between 30° and 60°, conductance is from 15 to 20 percent lower than conductance assuming diffuse reflection from smooth walls. Experiment and calculation agree within ±4 percent. (auth)

31732 HYDRAULIC AND HEAT TRANSFER MEASUREMENTS IN AN ANNULUS WITH ROUGHENED INNER TUBE. G. Grunwald (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 300-7(May 1964). (In German)

Investigations were carried out using water under turbulent flow conditions. Optimum parameters for surface roughness were established and relations were established between pressure drop, core pressure, and thermal transmission. These relations were expressed by a modified Nusselt factor. Optimum results were attained when the degree of surface roughness was such that it caused maximum permissible resistance to the flow; this condition also resulted in optimum thermal transmission through the wall

of the annular section. The equations developed for the characterization of the relationships involved are suitable for the convenient calculation of reactor-cooling installations. (OTS)

31733 TEMPERATURE DISTRIBUTION AND EFFICIENCY OF RADIATIVE AND CONVECTIVE FIN ACCOMPANIED BY INTERNAL HEAT SOURCE. Yoshizo Okamoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Kikai Gakkai Rombunshu, 30: 267-77(Feb. 1964). (In Japanese)

The character of a radiative and convective finned surface accompanied by an internal heat-source is described. The steady-state conduction heat-transfer equation of a finned surface was introduced and solved by using a digital computer. Thus, temperature distribution and radiative, convective efficiency were derived. The value of radiative and convective heat-transfer ratio can be calculated. (auth)

31734 SOME CONSIDERATIONS OF RADIATION IN MAGNETOHYDRODYNAMIC COUETTE FLOW. Raymond Viskanta (Purdue Univ., Lafayette, Ind.). Z. Angew. Math. Phys., 15: 227-36(1964).

The effect of a magnetic field on the temperature distribution and energy transfer when the gas is not only an electric conductor but also capable of emitting and absorbing thermal radiation was studied for generalized Couette flow. Because of the nonlinearity of the energy equation, analytical solutions were not possible, and the temperature distributions were evaluated numerically for some values of the parameters of interest. The heat transfer characteristics were calculated and are tabulated. The difference between results for an opaque and a transparent moving wall were examined. (M.C.G.)

31735 HEAT EXCHANGER. (to Fives-Penhoët). French Patent 1,294,954. Apr. 24, 1962. Filed Apr. 22, 1961.

A heat exchanger for a gas-cooled nuclear reactor consists of a cylindrical outer casing enclosing an inner casing open at its upper end. This interspace between the casings is composed of tubes helically wound on the inner casing and serving as evaporator tubes while the inner casing encloses a bundle of vertical tubes in which the formed steam is superheated. The hot reactor cooling gas enters the inner casing at its bottom, rises upwards within the inner casing and flows down in the annular interspace before leaving the outer casing via a lateral opening in the proximity of its bottom. The inner casing may be extended at its bottom by a horizontal inlet duct passing through the side wall of the outer casing while the gas leaves the heat exchanger at the bottom of the outer casing. (IIB)

Materials Testing

31736 (HW-79844) DIFFUSION OF EDDY CURRENTS. K. W. Atwood and H. L. Libby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 51p.

A study was made of the diffusion of eddy currents in a flat, thick metal. The calculated eddy current distribution due to a plane electromagnetic wave impinging on the metal surface is shown. The current density at a given depth reaches a peak value at a time proportional to the square of the depth from the surface. The use of this time and corresponding depth to calculate a "propagation velocity" is not recommended because of the variation of such a "velocity" with depth. The magnetic field of an isolated cylindrical coil is shown. The field strength of the coil is dependent on the radius of the coil; thus, the depth of penetration of eddy currents in a conductor placed adjacent to such a coil is expected to be a function of coil geometry as well as frequency and conductor electrical characteristics. The effect of coil geometry should have least influence when the coil diameter is large compared to the depth of penetration of currents in the conductor. The actual distribution and diffusion of eddy currents induced in liquid Wood's metal were determined by measuring the current in pick-up loops placed in the metal. A cylindrical drive coil was used adjacent to the metal surface and a step function current was used for excitation. Results of these measurements show that the currents decay much more rapidly than calculated currents for the plane wave case. It was also noted that the current densities at different depths approach the current densities at the surface much sooner than in the plane wave case. These effects are believed to be due to the difference in geometry of the two cases. In the plane wave case diffusion takes place in only one direction, normal to the surface. In the cylindrical coil case diffusion takes place in three dimensions, permitting a faster redistribution of currents. The measurements also show that the rate of decay of the eddy currents is a function of the distance from the axis of the drive coil, with the decay rate decreasing as the distance from the coil axis increases. Two simplified models for use in representing eddy current phenomena were studied. A five mesh transmission line or ladder network and an array of five inductively coupled loops were simulated with an analog computer. It was found that the transmission line model can be used to represent the plane electromagnetic wave case, but that the inductively coupled loop model can be made to represent a closer analogy to the practical eddy current problem. The study of the coupled loop model and the role played by the mutual coupling between current loops resulted in an explanation of the variation in waveform of the current flow at different depths in the metal. (auth)

31737 TWO APPROACHES TO AOQ. C. R. Clark and W. J. Zimmer (Sandia Corp., Albuquerque, N. Mex.). Ind. Quality Control, 20: 11p. (Jan. 1964). (SC-R-64-100)

The two different approaches to the AOQ concept as applied to lot sampling are described. The difference in these approaches depends on the definition of the abscissa of the AOQ curve. The abscissa can be regarded as either the exact fraction defective of lots submitted for inspection or as the process average of lots submitted for inspection when each lot can be considered a random sample from a universe having a given fraction defective (the process average). The differences between these approaches and their effect on the AOQ are outlined. Equations for the AOQ for several different situations within each approach were derived. (auth)

31738 AN EVALUATION OF AN ULTRASONIC INSPECTION SYSTEM EMPLOYING TELEVISION TECHNIQUES. J. E. Jacobs (Northwestern Univ., Evanston, Ill.), W. J. Collis, and Harold Berger. Mater. Evaluation, [22]: 4p.(May 1964).

An ultrasonic imaging system employing a newly developed television camera tube that responds directly to ultrasonic energy is described. The camera tube, having a 2 in. dia. piezoelectric target and faceplate, converts an ultrasonic image into an electronic signal, which can then be displayed by standard television methods. The capabilities of the imaging system for nondestructive testing applications are demonstrated by comparing the test results obtained by the cinesonographic techniques against those

obtained using a mechanically scanned ultrasonic imaging system and x radiography. In addition, the advantages of the television imaging system over conventional ultrasonic inspection methods are discussed. (auth)

31739 ELEKTRONNO-AKUSTICHESKIE I RADIOMETRICHESKIE METODY ISPYTANIYA MATERIALOV I KONSTRUKTSII. (Electron-Acoustic and Radiometric Methods for Testing Materials and Structures). N. A. Krylov. Leningrad-Moscow, State Publishing House of Literature on Construction, Architecture, and Building Materials, 1963. 241p.

An analysis was made of various electron-acoustical and radiometric methods for the nondestructive testing of physicomechanical properties of various construction materials. Descriptions are given of various existing methods of wave dispersion, reflection, diffraction, friction, and oscillations and photoelectric absorption, Compton scattering, pair formation and other radiometric methods. Results of practical application in the investigation of concrete, ground, icebergs, hardening and density of iron construction concretes are reviewed as well as automatic technological processes. A short review is also given of portable field equipment for pulse, vibration, and radiometric tests. (R.V.J.)

Protective Structures

31740 (FMRC-15328) FIRE HAZARD TO FALLOUT SHELTER OCCUPANTS: A CLASSIFICATION GUIDE. Final Report. J. B. Smith, E. W. Cousins, and R. M. Newman (Factory Mutual Research Corp., Norwood, Mass.). Apr. 3, 1964. Contract OCD-PS-64-40. 49p. (AD-600261)

A method of classifying the hazard from fire to occupants of fallout shelters is presented. It represents, in the form of a simple survey, a conservative fire-protection-engineering approach with a high confidence factor. The intention of this study is not to relate fire safety to weapons effects; instead it addresses the problem that, should fires occur from any cause, would the occupants of a particular fallout shelter be safe from fire? Further, the guide does not attempt to define the relative degrees of hazard, or probability of hazard, for non-sprinklered shelter buildings which are not unequivocally considered safe. Assuming that fires from any cause have occurred following a nuclear attack; that there is no fire storm; that there will be no fire fighting by public fire department; that public water supplies and electric utilities will be in service; and that automatic sprinklers, as available, will be in service, the fire hazard to shelter occupants is analyzed. Safe separation distances between buildings were determined from British work and some conservative simplifying assumptions. A manual, "Fire Hazard to Fallout Occupants: A Classification Guide," was prepared for the use of architects and engineers. The guide was field-tested by several architects and a consulting engineer. Trial surveys were made at existing designated shelters in buildings of varied construction, occupancy, and age, in relatively congested areas. In general, the guide was found to be simple and easy to use. Consistent results were obtained. (auth)

31741 DETERMINATION OF THE STRESSES AROUND THE HOLES OF PRESSURE-VESSEL COVERS SUBJECTED TO INTERNAL PRESSURE. L. Varga. Forsch. Gebiete Ingenieurw., 29: 15-22(1963). (In German)

Cylindrical pressure vessels with spherical covers or with covers formed as compound curves of rotation are used in nuclear technology. Pipe connections to the pressure vessel pass through holes in the cover, which will vary in number and size according to the service of the pressure vessel. The internal pressure in the vessel causes additional stresses around the holes and these stresses must be allowed for by the designer. The basic relations, which hold good for the determination of the stresses around a fairly large hole, may be applied (by using the concept of stress superposition) to the case of a large number of holes. The validity of this procedure was confirmed by agreement between calculated and measured stresses. (UKAEA Information Bulletin, No. 21, May 25, 1964)

31742 THE HARWELL STANDARD LEAD-BRICK SHIELDING SYSTEM. R. A. G. Welsher (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.141-9 of "Lead 62." London, Lead Development Association, 1962.

The design of a lead-brick hot cell and the design specifications of the lead bricks are presented. The sphere units, windows, handling tongs, and master-slave manipulators are also discussed. (C.E.S.)

Vacuum Engineering

31743 (ORNL-3652(p.132-45)) VACUUM SYSTEMS, TECHNIQUES, AND MATERIALS STUDIES. (Oak Ridge National Lab., Tenn.).

The results of work on the chemical reactions and physical behavior of organic compounds in vacuum systems are described. The sequential desorptions of compounds from surfaces were experimentally studied during a temperature increase from 80 to 300°K. Of the ten desorption peaks observed, six were identified, viz. methane, carbon dioxide, ethane, propane, water, and butane. A derived relation between offgassing rates and the heat of adsorption of organic compounds is presented. Two methods of estimating heats of adsorption are discussed. The effect of electron bombardment is described for the special case of an octyl phthalate ester contaminant. The products of hot-filament reactions are contrasted with those from electron bombardment. Bombardment was used to assess the progress of a baking cycle and was found to substantiate earlier conclusions on the effects of ionization gage grid heating. Platinum was found to be superior to tungsten or tantalum when used with β-eucryptite as a lithium ion source. (auth)

31744 (UCRL-7914) DESIGN CONSIDERATIONS OF ULTRAHIGH VACUUM SYSTEMS FOR METALLURGICAL APPLICATIONS. T. H. Batzer and R. F. Bunshah (California. Univ., Livermore. Lawrence Radiation Lab.). June 10, 1964. Contract W-7405-eng-48. 21p. (CONF-603-4).

From Transaction of Meeting Vacuum Metallurgy American Vacuum Society, New York, June-July 1964.

The justification for the use of an ultrahigh vacuum system is in the prevention of recontamination of an initially clean surface so that special processes or tests may be carried out. Design considerations for such a system include leaks, outgassing, and pump contamination. (D.L.C.)

GEOLOGY AND MINERALOGY

General

31745 (A/CONF.28/P/257) APPLICATION OF GEOLOGIC CONCEPTS TO FUTURE URANIUM EXPLORATION. R. D. Nininger (Atomic Energy Commission, Washington, D. C.), J. W. Gabelman, and H. H. Adler. 10p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The concept of mineral zoning is investigated, insofar as it applies to the future prospecting for uranium deposits. The use of this concept for exploration within and outside the U. S. is considered. (T.F.H.)

31746 (ARA-1052) ON-SITE SELF-POTENTIAL AND RESISTIVITY MEASUREMENTS. Arnold Glaser and Robert Kruszyna (Allied Research Associates, Inc., Boston). Apr. 17, 1962. Project GNOME. 17p.

The time variation of the self-potentials at the earth's surface resulting from the underground detonation of a nuclear device was measured during the Gnome event. The potential difference between two electrodes, 500 ft and 3000 ft from surface ground zero, was monitored during the period 5 December 1961 to 18 December 1961. On 10 December 1961, immediately after the detonation of the Gnome device, the measured potential rose sharply in 12 to 16 hours to a maximum of about 15 millivolts above ambient. The potential then decayed gradually toward the ambient in the ensuing seven days. This measurement indicates that a deep underground nuclear explosion produces effects in the potential distribution observed at the earth's surface. The measurement of self-potentials at the surface may be a means for on-site location of a clandestine underground test. An attempt to monitor the change in earth resistivity during the Gnome event was not successful because the signal could not be distinguished from noise. (auth)

31747 (UCRL-13109) ANALYSIS OF EARTH MOTION ACCELEROGRAMS. Victor Jenschke, Ray W. Clough, and Joseph Penzien (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 1964. For Univ. of California, Lawrence Radiation Lab., Livermore. Contract W-7405-eng-48. 168p. (SESM-64-1)

The response spectra technique was investigated for correlations of strong-motion earthquakes to underground high-yield nuclear explosions. The Fourier spectra and the power spectral density were applied to earthquake accelerograms for a number of past earthquakes. An efficient Fortran II program for IBM 7090 was developed for spectral calculations, and numerical results were plotted directly using CALCOMP. Special attention was given to the influence of seismometer characteristics on the recorded data. (R.E.U.)

31748 VARIATIONS OF THE INITIAL CONTENT OF Sr^{87} IN GRANITOIDS DURING GEOLOGICAL TIME. Yu. M. Artemov and I. M. Gorokhov. Geokhimiya, No. 5, 481-2 (May 1964). (In Russian)

The transformation of ^{87}Sr into ^{86}Sr in granitoids was used as a means for estimating the geological age of rocks. A table is given of four groups of rocks (granites, gneissoid granites, pegmatites of Enisei and South Korelian regions). The results indicate an increase of about 1.5% in the initial ratio of $^{87}Sr/^{86}Sr$ during the last 2.7×10^9 years. The results were used as a criterion for correction of age estimates by the Rb–Sr method used by P. M. Hurley et al. (J. Geophys. Res., 67: No. 13, 5315, 1962). (R.V.J.)

Natural Radioactivity and Fallout

Refer also to abstracts 31784, 31788, 31792, 31797, 31798, 31799, and 31832.

31749 (A/AC.82/G/L.932) REPORT ON FALLOUT AND RADIOACTIVE CONTENT OF THE FOOD CHAIN IN U.A.R. DURING THE YEAR 1962. K. A. Mahmoud, F. H. Abd El-Said, and A. T. Abd El-Fatah (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). Sept. 1963. 15p.

Data are tabulated on the fallout radioactivity in samples of air, food, and soil collected at various locations in the United Arab Republic during 1962. Data are included on the content of ^{90}Sr in soil, milk, cheese, cereals, fresh vegetables, and average diet and the content of ^{137}Cs in soil, milk, imported food items, and average diet. (C.H.)

31750 (A/AC.82/G/L.933) SUMMARY OF DATA ON FALLOUT AND RADIOACTIVE CONTENT OF CERTAIN FOOD ITEMS IN U.A.R. DURING THE FIRST QUARTER OF 1963. M. K. Molokhia and S. A. Abdel-Latif (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). 1963. 5p.

Data are presented on the fallout radioactivity in samples of air, drinking water, fish, cereals, and fresh vegetables collected at various locations in the United Arab Republic during the first quarter of 1963. Data are included on the content of ^{90}Sr in samples of drinking water, Nile River fish, cereals, and vegetables. (C.H.)

31751 (AERE-HP-GEN-39) THE GAMMA RADIATION BACKGROUND AT GROVE, BERKSHIRE. J. A. B. Gibson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 4p.

The dose rate due to γ radiation background was measured continuously over open grassland at Grove, Berks, from August 1961 to December 1963. The experiment was designed to measure changes in this background and during this period the main effects were due to nuclear weapon fallout. The calculated dose due to fallout for August 1961 to December 1961 is 5 mr, for 1962 27 mr, and 1963 31 mr. (auth)

31752 (BLG-243) NATURAL AND ARTIFICIAL RADIOACTIVITY MEASUREMENTS OF NAPLES AND MISAKI PLANKTON. A. Terzagh (Centre d'Étude l'Énergie Nucléaire, Brussels). Nov. 1963. 14p.

The radioactivity of plankton samples from the Gulf of Naples and from the Pacific Ocean (Misaki) was measured during 1959 and found to be of the same order. The radioactivity level of Misaki sea water appeared eight times higher than the natural background. Fission products accounted for a large proportion of the radioactivity in plankton. Long-lived fission products were not accumulated by Misaki plankton. Neutron activated radionuclides were not detected in plankton by gamma spectrum analysis. (auth)

31753 (CLOR-26) RADIO-ACTIVITÉ D'UNE SÉRIE D'ORGANISMES AQUATIQUES ET TERRESTRES EN RAPPORT AVEC LA RADIO-ACTIVITÉ DE LEUR MILIEU AMBIANT. (Radioactivity of a Series of Aquatic and Terrestrial Organisms in Relation to the Radioactivity of Their Ambient Environment). Stanislaw Wlodek (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1963. 22p.

The capacity of organisms such as terrestrial plants and marine zooplankton to accumulate radioisotopes from radioactive fallout was investigated. The research material was amassed in various locations: Poland, Western Europe, Atlantic Ocean, and South America. The results of the measurement of the global β activity of the waters of the Atlantic, marine zooplankton, several species of weeds, and the soil where they grow are tabulated. Conclusions were formulated on the level of radiocontaminations of the various soils examined, the organisms of the species examined most capable of accumulating radioisotopes, definition of the coefficients of accumulation, and the possibilities of appreciating the dimension of the radiocontamination of the milieu by examination of the organisms of this milieu. (tr-auth)

31754 (NDL-TR-58(Pt.I)) COLD WEATHER DECONTAMINATION STUDY — McCOY IV. PART I. J. L. Meredith, J. C. Maloney (Army Nuclear Defense Lab., Edgewood Arsenal, Md.); Howell G. Bradbury, and William R. Miller (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Apr. 1964. 113p.

Includes Appendices A through D.

Decontamination of various surfaces by various methods are dependent upon operator experience, equipment mechanical condition, and temperature. Within limitations that these variables are not adverse, the following conclusions can be made. (1) Loose snow can be decontaminated with a blade snowplow or motor grader to less than 5 percent remaining. Equipment than can leave less than 15 percent of the contaminant are carry-all scraper, bulldozer, hand snowshovel and plow, and rotary snowblower. (2) Ice can be decontaminated with corn brooms to less than 5 percent activity remaining. (3) Frozen ground can be decontaminated by mechanical sweeping to 3 percent activity remaining. Less than 15 percent remaining can be achieved with compressed air. (4) Thawing ground can be decontaminated with a bulldozer, carry-all scraper, hand shovel, or motor grader to less than 10 percent contaminant remaining. With repeated effort, less than 1 percent remaining can be achieved by these methods (excepting hand shovel, which was not determined). (5) Dry asphalt, concrete, and macadam can be decontaminated with compressed air, hand corn broom, fire hose, mechanical sweeper, or vacuum cleaner to less than 10 percent remaining. Wet surfaces can be effectively decontaminated by fire hosing. (auth)

31755 (NDL-TR-58(Pt.II)) COLD WEATHER DECONTAMINATION STUDY — McCOY IV. PART II. J. L. Meredith, J. C. Maloney (Army Nuclear Defense Lab., Edgewood Arsenal, Md.); Howell G. Bradbury, and William R. Miller (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Apr. 1964. 234p.

Includes Appendices E and F.

A series of tests were conducted at Camp McCoy, Wisconsin, to determine the effectiveness of maintenance, snow-removal, fire-fighting, and manual equipment to decontaminate snow, ice, frozen and thawing ground, paved surfaces, and roofs. Data are presented on decontamination of test plots and roofs and on fallout migration tests. (D.L.C.)

31756 (NP-14098) FALLOUT IN NEW ZEALAND. Quarterly Report January–March 1964. (New Zealand. National Radiation Lab., Christchurch). 19p. (NRL-F12)

The results of total γ-activity measurements on air filter samples from Auckland and Christchurch, New Zealand, for the first quarter 1964 were similar to those for the previous quarter. The total β activity of Christchurch rain during the first quarter 1964, however, was lower on the average than for the previous quarter. The average deposition of ^{90}Sr for nine New Zealand collecting stations increased from 0.46 mC/km^2 for the last quarter 1963 to 0.57 mC/km^2 for the first quarter 1964. The average specific activity of ^{90}Sr in rain from the same collecting stations increased slightly from 2.4 pC/l for the last quarter 1963 to 2.5 pC/l for the first quarter 1964. (auth)

31757 (JPRS-25068(p.16-29)) NATURAL RADIOACTIVITY OF OCEAN WATER. N. I. Popov. Translated from Okeanologiya, 4: 223-31(1964).

The content of the various naturally occurring radioisotopes in ocean waters was calculated, and from these data an estimate was made of the most probable mean chemical composition of radioactivity of ocean water. The energy of decay of the corresponding isotopes and radioactive families was also calculated. (C.H.)

31758 STRONTIUM-90 IN THE AUSTRALIAN ENVIRONMENT DURING 1961. F. J. Bryant, J. R. Moroney, D. J. Stevens, and E. W. Titterton. Australian J. Sci., 26: 69-74(Sept. 1963). (A/AC.82/G/L.875)

Data are reviewed on the ^{90}Sr content in samples of soil, precipitation, sheep bones, and human bones from individuals of various ages collected throughout Australia from 1957 through 1961. The mean daily per capata intake of ^{90}Sr from diet in 1961 was estimated from measurements made on various foodstuffs. Comparisons were made with similar data from the U.K. and U.S. It was concluded that any biological consequences to the population of Australia of these fallout levels would be insignificant. (C.H.)

31759 RADIOCARBON CONCENTRATION IN TAIWAN WOOD. Shig-chong Lu (Taiwan Weather Bureau), Yuin-kwei Tai, and Yuin-chi Hsu. Chinese J. Phys. (Taiwan), 2: 1-5(Apr. 1964).

Naturally occurring radiocarbon concentration is measured using tree samples of cypress grown in Taiwan. Acetylene is used as counting gas. The counter of 1,034 ml effective volume is enclosed by a multianode gas flow counter which provides the anticoincidence pulses. The whole counting system is shielded by iron sheets 25 cm thick. Results obtained with this apparatus are described. (auth)

31760 NUCLEAR TESTING AND RADIATION IN FOOD PRODUCTS. Jan Wozniak. Farm. Polska, 20: 167-71 (Mar. 1964).

Nuclear testing and radioactive fallout are discussed along general lines. The results of Operation Teapot in the Nevada Desert are described. The problems of ^{90}Sr contamination of vegetation, livestock, and milk and the radioactive contamination of drinking water are also considered. (OTS)

31761 ISOTOPIC COMPOSITION OF URANIUM AND THORIUM IN THE ZONE OF HYPERGENESIS. INVESTIGATION OF THE PEAT BOG MATTER. V. V. Cherdyntsev V. I. Malyshev, Z. A. Sokolova, I. V. Kazachevskii, and I. V. Borisov (Geological Inst., Moscow). Geokhimiya, No. 5, 399-403(May 1964). (In Russian)

The ratio of uranium and thorium isotopes in material from the peat bog of the Kirov District, USSR, and in the natural waters of the region was investigated. In the peat bog layers with different $^{234}U/^{238}U$ values were observed which corresponded to the difference in waters of the basin in which the peat bog matter was deposited. Uranium was leached from the bedrocks of the region as is shown by low $^{234}U/^{238}U$ ratio. The enrichment of the peat bog waters in isotopes of radioelements followed the series: (U ~ Th > Io > UX_1) and for waters of the enclosing rocks the series: (UX_1 > ^{234}U > ^{238}U > Io > Th). (auth)

31762 ISOTOPIC RATIO U^{234}/U^{238} IN NATURAL WATERS AND ITS USE FOR NUCLEAR GEOCHRONOLOGY. P. I. Chalov, T. V. Tuzova, and Ya. A. Musin (Inst. of Physics and Mathematics, Frunze, USSR). Geokhimiya, No. 5, 404-13(May 1964). (In Russian)

The method of nuclear geochronology was substantiated with the aid of the isotopic ratio $^{234}U/^{238}U$. Data on the absolute age of two drainless alpine lakes were obtained, which agreed with modern ideas about their relative age. Defects and advantages of this method for nuclear geochronology according to the isotopic uranium composition are discussed along with possible applications. (auth)

31763 A DIFFUSION-DEPOSITION MODEL FOR PARTICULATE EFFLUENTS FROM GROUND-TEST NUCLEAR ENGINES. Isaac van der Hoven (Weather Bureau, Washington, D. C.). Intern. J. Air Water Pollution, 7: 1023-32(1963).

A statistical model is used to describe the deposition of the particulate effluent resulting from the operation of the Kiwi-A reactor series at the Nevada Test Site. The basis for the model is the assumption that the particles are diffusing crosswind and vertically according to a gaussian distribution and are at the same time settling with a constant fall velocity. The model is further corrected to allow for the depletion of the diffusing cloud due to the deposition. Measured meteorological and deposition data in three cases are used to test the so-called tilted plume model. Results show reasonable agreement between observed and computed deposition for distances from a few km to about 50 km from the source under neutral or superadiabatic thermal lapse rates and under emission conditions such that a constant initial effective stack height can be assumed. (auth)

31764 SEASONAL VARIATION OF NATURAL RADIOACTIVITY AND SULPHUR CONSTITUENT CONCENTRATION IN THE AIR. Nobuhiko Murayama (Japan Meteorological Agency, Tokyo). Kishocho Kenkyu Jiho, 15: 432-40 (June 1963). (In Japanese)

It is found that seasonal variation of atmospheric radon daughter concentration, high in winter and low in summer, exists for a period of six years at five points in Japan. The cause is qualitatively considered from the point of view that large-scale meteorological or climatological conditions might markedly contribute to the seasonal variation while micrometeorological conditions contribute to the daily variation. It may be explained by the fact that continentally originated air prevails in winter while maritimely originated air prevails in summer in Japan. Air pollutants like airborne particulates or sulfur constituents in the air similarly show distinct seasonal variations with high concentration in winter and low in summer. Relations between the variation of concentration of these atmospheric minor constituents and various meteorological variables like atmospheric stability, wind (air mass), and precipitation are rather complicated. Further studies on scavenging of precipitation should be undertaken taking different physical and chemical properties of their constituents into account. (auth)

31765 EVALUATION OF THE ATMOSPHERIC RADIOACTIVITY IN CZECHOSLOVAKIA IN 1962. P. Hmu Petrovic (Inst. of Hydrometeorology, Prague). Meteorol. Zpravy, 27: 7-14(Feb. 29, 1964).

Methods and results of measuring atmospheric radioactivity, including monthly, weekly, and daily fallout are reported. It is pointed out that the spring maximum agrees with data according to the Dobson-Brewer model of stratosphere circulation. The frequency of individual synoptic situations in the period of high radioactivity is given and their relation to the tropopause disturbances discussed. A contradiction between the autumn maximum during a southern meridional air flow and the expected influx of radioactive aerosols from the north according to the circulation model is shown. The dependence of radioactivity in the weekly fallout on the total volume of precipitation is discussed. (OTS)

31766 THE RADIOACTIVE CONTAMINATION OF THE BIOSPHERE AND FOOD HYGIENE. Vasile Gheorghe. Natura, Ser. Biol., 16: 26-34(Mar.-Apr. 1964).

The nature and effect of radioactive contamination caused by nuclear testing are reviewed. Values of radioactive substances in various foods reported by numerous countries, including Italy, Great Britain, Japan, the U. S., etc., are given. Methods of measuring the radioactive contamination of foods are described and some suggestions on how to reduce the contamination of important foods listed. (29 references.) (OTS)

31767 ISOTOPIC COMPOSITION AND THE ATOMIC WEIGHT OF NATURALLY OCCURRING MOLYBDENUM: A POSSIBLE REFLEXION OF THE CREATION PROCESS. E. A. C. Crouch and T. A. Tuplin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 202: 1282-4(June 27, 1964).

The isotopic composition of molybdenum obtained from various sources was determined. The ratios of ^{94}Mo, ^{95}Mo, ^{96}Mo, ^{97}Mo, ^{98}Mo, and ^{100}Mo to ^{92}Mo were found to vary in the different samples. It is speculated that these variations may provide direct evidence concerning the synthesis of the elements. (C.E.S.)

31768 CONTAMINATION OF THE ENVIRONMENT BY IONIZING RADIATION ARISING FROM RADIOACTIVE ROCKS. Miguel M. Muhlmann. Semana Med., (Buenos Aires), 123: 709-18(Aug. 29, 1963). (In Spanish)

Contamination of the environment by radiation from radioactive rocks is discussed. A classification scheme for the environment was developed in accordance with the contaminating elements. A radioactive granite from the province of Cordoba, Argentina, with zircon and apatite included in biotite and enclosed by pleocroic halos is described. Radioactive monazitic sands from Brazil are also described. Some possible biological effects of the radiation from these materials are discussed. (auth)

31769 MASS SPECTROMETRIC STUDY OF THE RARE GASES IN RADIOACTIVE MINERALS. Hitoshi Sakai (Okayama Univ., Japan). Shitsuryo Benseki, 10: 55-71 (Oct. 1962). (In Japanese)

The first three chapters describe the four kinds of nuclear reactions in uranium and thorium minerals (α-decay, spontaneous fission, (α,n) and (α,ϕ), and (n,γ), and neutron fission) and the half lives of spontaneous fission. It is concluded that most of the spontaneous fission products in uranium and urano-thorium minerals

are produced by the ^{238}U spontaneous fission. Chapter 4 summarizes various papers on fundamental studies of Xe and Kr in uranium minerals, neutron fission of ^{235}U in uranium minerals, fissiogenic Xe and Kr in uranium minerals and spontaneous fission product patterns corrected for the neutron fission, and the absolute yields of Xe and Kr in ^{238}U spontaneous fission. Chapter 5 deals mainly with studies published by the author and other investigators on ^{38}A and ^{21}Ne in uranium minerals. Especially, studies on the nuclear reactions of (α,n) and (α,ϕ) in uranium, the relation between the yield of ^{38}A and the content of uranium, and the dependence of the content of ^{38}A on chlorine (as an impurity) in uranium minerals are discussed in detail. It is concluded that it is probably safe to say that the reaction rate of α particles and light elements in uranium minerals is almost independent of the uranium content, but varies with the relative positions of these elements in minerals. Chapter 6 deals mainly with the relation between the uranium content and the ^{235}U neutron fission. Mathematical derivations of the rate ratio of ^{235}U neutron fission and ^{238}U spontaneous fission, the resonance escape probability, and the thermal utilization factor are described in this chapter. Some discrepancies were found between the results by various investigators, and it is concluded that it is very desirable to compare the mass spectroscopic data on rare gases and the complete chemical analyses of minerals because of the considerable inhomogeneity of the constituents of the uranium minerals. In chapter 7, fission products in thorium minerals and the isotope abundances of Xe in five urano-thorium minerals are described. It is concluded that the neutron fission is proportional to the thorium-to-uranium ratio in urano-thorium minerals, and neutrons by (α,n) reactions are more important in thorium minerals than in uranium minerals. (NSA of Japan)

31770 THE CONTENT OF RADIOACTIVE Sr^{90} AND Cs^{137} IN MILK IN THE YEARS 1955-1961. E. Knoop, A. Enda Marah, and O. Paakkola (Bundesforschungsanstalt fur Milchwirtschaft, Kiel). p.515-20 of "XVI International Dairy Congress." Copenhagen, 1962. (In German)

Data are presented on the radioactivity in milk samples collected in Germany from 1955 through 1961. The ^{90}Sr content of samples was determined from 1955 and the ^{137}Cs content was determined from Jan. 1961. After the termination of nuclear weapons tests in 1958 the radioactivity of milk increased until a peak was reached in 1959, followed by a marked decrease by 1961. (C.H.)

31771 THE EXPOSURE OF THE POPULATION TO RADIATION FROM FALLOUT. A Report to the Medical Research Council by Their Committee on Protection Against Ionizing Radiations. (Gt. Brit. Medical Research Council, London). 1964. 11p. 1s.(HMSO).

Estimates were made of the maximum somatic radiation doses to the population attributable to fallout due to nuclear weapons tests up to 1964. Emphasis is placed on the concentrations of ^{90}Sr that may be reached in the bones of young children. Data are reviewed from direct measurements of the ^{90}Sr content in bones of various age groups; surveys of environmental and dietary contamination, with emphasis on the ^{90}Sr content in milk; estimates of the levels of ^{90}Sr in the bones of infants based on measurements of dietary levels; estimates of the content of ^{90}Sr in bone resulting from nuclear tests; estimates of additional radiation dose to bone from other components of fallout, with emphasis on ^{137}Cs and ^{131}I; and estimates of the total radiation dose to bone and bone marrow from all components of fallout. It was concluded that in 1963, children of about one year of age had the highest radiation dose in bone, with an average dose of about 20 millirem from ^{90}Sr and a total dose from all fallout components of about 30 millirem. These estimated radiation doses in bone are considerably below the maximum permissible exposure doses established by the Medical Research Council. (C.H.)

Site Survey and Selection

31772 INVESTIGATION OF THE RADIOACTIVE CONTAMINATION AROUND THE NUCLEAR REACTOR IRT-1000. I. T. Mishev, M. A. Radicheva, and T. M. Troshev (Inst. of Physics, Sofia). At. Energ. (USSR), 16: 344-9 (Apr. 1964). (In Russian)

Contamination of the area surrounding a reactor by radioactive aerosols and gases presents a special danger for populated areas and agricultural regions. The contamination may include accidentally released fission products or Ar generated during the normal operation of the reactor. The reactor IRT−1000, obtained from the Soviet Union was started up during September 1961 at a location near Sofia. In order to ascertain that the safety requirements have been met, the activity of soil, vegetation and air samples was determined periodically, starting the survey several months prior to the startup of the reactor. The specific β-activity was measured with reference to a K standard. Water samples were also taken both from the pipelines and from the open reservoirs; the air was sampled by filtering out the aerosols. On the basis of these measurements, which are being continued, it can be stated that the Ar content of the air samples taken near the reactor does not exceed the background. Tests made with water obtained by melting of snow taken on Aug. 12, 1962 in the Vintosh region exhibited a specific β-activity of 1660 ± 37 pcurie/l after filtration, while the activity of the filter residue was 32600 ± 386 pcurie/l. This relatively high activity was attributed to the bomb tests carried out up to that period. Similar conclusions were reached with respect to the activity of the aerosols. (TTT)

Techniques and Equipment

31773 FISSION TRACK EVIDENCE FOR THE SIMULTANEOUS ORIGIN OF TEKTITES AND OTHER NATURAL GLASSES. R. L. Fleischer and P. B. Price (General Electric Research Lab., Schenectady, N. Y.). Geochim. Cosmochim. Acta, 28: 755-60(June 1964).

The procedure of fission track dating is reviewed and recent age and annealing results summarized. Measurements are reported on australites, obsidians, clearwater lakes glass, and Darwin glass. Assuming that australites were formed in a single event, it occurred about two thirds of a million years ago and was contemporaneous with the formation of Darwin glass. By dating flanges, it is shown that australites entered the Earth's atmosphere at this same time. It was found, within the experimental accuracy of the techniques used, that the following four glasses were formed at the same time as were the major groups of tektites: Darwin glass (fission track dating); Ries Kessel glass (K−Ar dating); Libyan glass (fission track dating); and clearwater lakes, Quebec glass (fission track dating). It was concluded that assorted objects of widely different sizes dropped on Earth along with the tektite falls in Eastern Asia, Europe, and America. (auth)

31774 MEASUREMENT OF DENSITY AND MOISTURE IN POROUS ROCK BORINGS BY NUCLEAR METHODS. V. Cotecchia (Università, Bari, Italy). Geotecnica, No. 3, 1-24(1963). (RT/GEO(64)4). (In Italian)

Advantages that the nuclear method has in comparison with the usual laboratory methods are listed. Characteristics of the two radioactive probes used in this study are described and the nuclear physics on which the two kinds of measurements are based is outlined. The laboratory and field operations developed in order to draw calibration curves of the two probes are given. The most important interferences and anomalies that can arise in the density measurements (cavity occurrences, contacts among media with different density, influence of the various access tubes, anomalous behavior of the water, etc.) and in the moisture measurements (organic matter effects; influence of the access tubes; effect of the salt concentration, of the hydrogen content and of the ignton water of the clay) are given. Results of the experimental measurements, carried out in situ with different kinds of rocks in boreholes showed the difficulties in the work procedures and the devices adopted in order to obtain accurate measurements. (auth)

Thorium and Uranium Minerals

31775 (RME-4546) RECONNAISSANCE FOR URANIUM IN THE PERUS AREA, SÃO PAULO, BRAZIL. John W. Gabelman (Division of Raw Materials, AEC). Dec. 1963. 12p.

Regionally metamorphosed Precambrian gneiss, schist, phyllite, and limestone constitute the matrix rocks of the Perus area, São Paulo, Brazil. The granites and granite pegmatites intruding this complex have a higher background radioactivity than the schist. Most hydrothermal activity in the area was of high temperature and probably associated with granite emplacement. Uraninite, pitchblende, autunite, metatyuyamunite, and torbernite have been identified along joint fractures, mostly in pegmatites but to some extent also in schist and phyllite. These uranium minerals and anomalous radioactivity are more widespread than is common for uraniferous pegmatite areas, and possibly a later, cooler period of hydrothermal activity may have occurred in the area. If this is the case, more significant uranium concentrations may exist adjacent to such low-temperature sectors. (auth)

31776 METAMORPHISM OF URANIUM DEPOSITS AND OF INDIVIDUAL URANIUM MINERALS. A. I. Tugarinov, E. V. Bibikova, and S. I. Zykov. At. Energ. (USSR), 16: 332-42(Apr. 1964). (In Russian)

The age determination of U–Th ores on the basis of isotopic ratios is greatly affected by the loss of Pb and U, removed by dissolution in Cl^-, $SO_4^=$ and $CO_3^=$ containing interstitial water. Hydrothermal metamorphism, involving repeated magmatic activity must also be taken into account. As an example, the hydrothermal metamorphism of the U deposits at Witwatersrand, South Africa, the Lake Athabaska region, together with certain pegmatites from Karelia were more closely examined. Migration of the radiogenic Pb from the U mineral beds and redeposition of the U ores was considered a clear indication of recent metamorphism of the U mineral; the time and intensity of the process were determined from the age variation of uraninites, obtained on the basis of the $^{207}Pb/^{235}U$ and $^{206}Pb/^{238}U$ ratios, and from the isotopic composition of anomalous Pb galena found in the same general area. The stages of metamorphism of U minerals include an early stage, characterized by the deposition of radiogenic Pb in the form of Pb minerals; a later stage, during which the Pb minerals are removed from the U bed without affecting the structure of the U minerals, and a regeneration stage, involving the reprecipitation of the radiogenic Pb and U from the primary U ores. Experimental reconstruction of the metamorphic phenomena under controlled laboratory conditions confirmed the fact that U may be selectively removed from uraninite ores. (TTT)

31777 ISOTOPIC FRACTIONATION OF URANIUM RELATED TO ROLL FEATURES IN SANDSTONE, SHIRLEY BASIN, WYOMING. J. N. Rosholt, E. N. Harshman, W. R. Shields, and E. L. Garner. Econ. Geol., 59: 570-85(June-July 1964).

Significant isotope fractionation of uranium was found in sandstone-type deposits in the Shirley Basin, Wyoming. Uranium deposits occur in unaltered sand adjacent to altered sand and the isotope fractionation appears to have taken place near this contact. Ratios of $^{234}U/^{235}U$ approaching radioactive equilibrium occur in unaltered sand above and below the ore, whereas ^{234}U deficiencies of 7 to 22% are found in ore. ^{234}U excess of as much as 70% is found in the altered sand tongue near the ore. In the mechanism of isotope fractionation, it is considered that ^{234}U is contributed to the environment in two ways: some of the ^{234}U atoms are mixed, transported, or precipitated with ^{238}U and ^{235}U and subsequent changes in their isotopic ratios are caused primarily by radioactive decay of ^{234}U and the remaining ^{234}U atoms are generated in situ from the radioactive disintegration of precursors, ^{234}Th and ^{234}Pa, and thus are subject to differential migration with respect to the ^{238}U from which they were derived. (auth)

31778 RADIOACTIVE DISEQUILIBRIUM STUDIES OF ROLL FEATURES, SHIRLEY BASIN, WYOMING. J. R. Dooley, Jr., M. Tatsumoto, and J. N. Rosholt (Geological Survey, Denver). Econ. Geol., 59: 586-95(June-July 1964).

Radiochemical analyses of ^{230}Th and ^{231}Pa using an alpha spectrometer were made on three suites of samples from roll features in the Shirley Basin, Wyoming. These isotopic abundances were compared with those of the parent ^{234}U and ^{235}U isotopes previously determined with a mass spectrometer. Unaltered sand above and below uranium ore has a low $^{230}Th/^{231}Pa$ ratio compared to a $^{234}U/^{235}U$ ratio that is near the normal reference ratio. Altered sand has a higher $^{230}Th/^{231}Pa$ ratio than ore samples or unaltered sand. Uranium ore contains both ^{230}Th and ^{231}Pa in excess of the amount required for equilibrium with ^{234}U and ^{235}U. The excess ^{230}Th and ^{231}Pa in ore indicates the presence, in the water-saturated sandstone, of pore water containing anomalously large amounts of uranium in solution. (auth)

31779 OPREDELITEL' MINERALOV URANA I TORIYA. (Identification of Uranium and Thorium Minerals). E. Z. Bur'yanova. Moscow, Gosgeoltekhizdat, 1963. 60p.

A compilation of data is given on determination and classification of uranium and thorium minerals. Descriptions include information on the crystallization and physical properties of 133 minerals and their compounds. The luminescence cation and anion properties of uranium and thorium minerals are analyzed. Extensive tables are included on chemical properties and reactions of the minerals with various acids and salts. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 31082, 31083, 31771, and 32069.

31780 (A/CONF.28/P/279) SAFETY ASPECTS OF SPENT FUEL TRANSPORT. John W. Langhaar (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.), Alexander E. Aikens, Jr., Nelmar J. Rigstad, Harold E. Walchli, and Lyle L. Zahn, Jr. 12p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The definition of conditions for cask malfunction or accident is considered. Handling and performance of the shipping casks are reviewed for actual and mockup accidents. (R.E.U.)

31781 (A/CONF.28/P/286) AEROSPACE SAFETY OF ISOTOPIC AND REACTOR POWER SOURCES. Glenn A. Fowler (Sandia Corp., Albuquerque, N. Mex.). 15p.

Preparation for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Problems related to nuclear safety associated with launch pad accidents, launch aborts, and re-entry for space power plants of isotopic and reactor types are discussed. Plans for research programs and the results of the flight test program are also included. (P.C.H.)

31782 (A/CONF.28/P/288) ATOMIC ENERGY FOR SOCIETY AND THE BALANCE BETWEEN HAZARD AND GAIN. J. H. Sterner (Eastman Kodak Co., Rochester, N. Y.). 6p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The health problems presented by atomic energy are discussed from the point of view that recognizes the inherent risk and hazards in every job and industry. The past experience in hazards of technological developments is surveyed briefly, and it is pointed out that the cautious approach to radiation differs from that taken to other industrial hazards in the past. The analogies between lead and radiation are described. It is emphasized that experience on radiation should be reviewed and its hazards placed in proper perspective. (D.L.C.)

31783 (CEX-64.3) ICHIBAN: THE DOSIMETRY PROGRAM FOR NUCLEAR BOMB SURVIVORS OF HIROSHIMA AND NAGASAKI. A Status Report as of April 1, 1964. J. A. Auxier (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 30p.

In 1956, the Health Physics Division of the Oak Ridge National Laboratory undertook the task of developing a method of evaluating the radiation doses received by the survivors of the nuclear bombings of Hiroshima and Nagasaki, Japan. Data for this project were obtained in nuclear weapons tests, Operation BREN, laboratory experiments, physical surveys in Japan, and in calculational studies. The approach to the problem has been as fundamental as possible with emphasis on quantitative measurements and calculations of the energy, angular, and spatial distributions of weapons radiations in an air-over-ground geometry. Spatial distributions of dose in various shields, including Japanese dwellings, were measured. Techniques were developed in Japan for verifying the location of survivors and accurately describing their shielding environments. Simple empirical equations were developed which permit the calculation of the shielding factors for Japanese residential-type structures with a probable error of approximately ±6%. (auth)

31784 (HASL-146) FALLOUT PROGRAM. Quarterly Summary Report, March 1–June 1, 1964. Edward P. Hardy, Jr., Joseph Rivera, and William R. Collins, Jr. (New York Operations Office. Health and Safety Lab., AEC). July 1, 1964. 264p.

Current data are presented from the HASL Fallout Program, the New Zealand Department of Scientific and Industrial Research, the National Radiation Laboratory in New Zealand, Argonne National Laboratory, and Hazleton-Nuclear Science Corporation. Radionuclide levels in fallout, milk, tap water, and upper air samples collected between March and June, 1964, are given in tabular form. Also included are interpretive reports and notes dealing with air radioactivity measurements along the slope of Mauna Loa Volcano, global deposition of ^{90}Sr during 1963, ^{137}Cs in foods as measured by gamma spectroscopy and a radiochemical method, and ^{90}Sr in human bones during 1963. A bibliography of recent literature pertinent to fallout studies is included. (auth)

31785 (HW-SA-3539) DECONTAMINATION CAPABILITIES. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1964. Contract AT(45-1)-1350. 20p.

A brochure is given on current status and capability of the equipment decontamination and solid waste handling facilities at Hanford. The high- and low-level decontamination facilities are described. Some of the improvements in the decontaminations are illustrated with examples. Progress in the burial of contaminated waste is also summarized. (D.L.C.)

31786 (LADC-4467) EVALUATION OF $Sr^{90} + Y^{90}$ SURFACE CONTAMINATION USING RADIATION SURVEY INSTRUMENTS. Jerome E. Dummer, Jr. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 34p. (CONF-555-2)

From the International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

The use of portable Geiger-Müller radiation survey meters for the quantitative determination of β-emitter contamination was examined. The indicated dose rate of several other types of γ-ray calibrated survey instruments was related to the true surface dose rate from the β source using $^{90}Sr + ^{90}Y$ in equilibrium as the source of beta radiation. A simple method for making large area sources simulating uniform surface contamination was developed. A standard solution was evaporated by the dotting technique on lucite and other materials. Saturation backscattering factors, relative to lucite, were measured for $^{90}Sr + ^{90}Y$ deposited on various materials. The effect of source size on the response of a G-M instrument as a function of source-detector distance was measured. These measurements provide a correlation between mr/hr indicated by the instrument and either total μC or $\mu C/cm^2$ for ^{90}Sr contamination. For the detector geometry given the limits of infinite source conditions as a function of source size and source-detector distance can be inferred. Infinite conditions are established to within 90% when the ratio of source diameter to source-detector distance is 7. Surface dose rates from several of the ^{90}Sr sources were determined with an extrapolation ion chamber and compared to

indicated mr/hr readings obtained with a variety of β-γ measuring instruments. Correction factors as high as 120 were found necessary for the instruments examined. The sensitivity of various instruments in detecting ^{90}Sr surface contamination was determined. A 1.2×10^{-3} μC point source or a 3.6×10^{-5} $\mu C/cm^2$ extended source gives a reading at contact of 0.1 mr/hr, using the G-M instrument studied. A simulated spill of ^{90}Sr was evaluated, using two methods developed in this study. The quantity of ^{90}Sr was rapidly determined with a standard G-M instrument to within 10%. A currently accepted permissible level of ^{90}Sr surface contamination was examined with regard to the potential biological hazard. (auth)

31787 (NDL-TR-63) A COMPILATION OF CAMP CENTURY ENVIRONMENTAL MONITORING DATA FROM JUNE 28, 1962 TO OCTOBER 9, 1963. George D. Oliver, Jr., Uldis I. Ievans, David T. Kilminster, and John H. McNeilly (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). June 1964. 41p.

The U. S. Army, in cooperation with the Danish government, chose Camp Century, Greenland, as a test installation for the Army Package Power Reactor (SM-1). The 1500-kw (electric) light boiling water reactor was installed during the summer of 1960 and went critical Oct. 2, 1960. The reactor test program at Camp Century was terminated on Oct. 8, 1963. The nuclear fuel was removed in shipping casks on Sept. 28, 1963, and all radioactive water was drained into the liquid waste discharge well by Oct. 6, 1963. Data are summarized on the α and β radioactivity in samples of air, water, and melted snow collected between June 1962 and Oct. 9, 1963. Some data are included for a 3-month period after the cessation of reactor operations. (C.H.)

31788 (NP-14052) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 2, No. 4. (Canada. Dept. of National Health and Welfare, Ottawa). Apr. 1964. 62p.

In English and French.

Data are summarized on the radioactivity in samples of air, precipitation, milk, and soil collected at various locations in Canada during March 1964. Results are compared with data collected during 1963. Results are also included from reactor environment monitoring, personnel monitoring, isotope safety assessments, and field investigations of radiation safety. (C.H.)

31789 (NUS-167) PARTICLE REENTRY INTERACTIONS. Ralph S. Decker, Jr. (Space Nuclear Propulsion Office, AEC/NASA) and Morton I. Goldman (Nuclear Utility Services, Inc., Washington, D. C.). Jan. 20, 1964. Contract [AT(30-1)-2815]. 46p.

The problems associated with the premature re-entry of fragments of a high power density nuclear rocket reactor require continuing examination to determine the probabilities and magnitudes of radiological effects. The results of a re-examination of the anticipated problems incorporating additional information that has been developed since the last review, and indicating areas of research necessary to further refine the estimates, are described. Interaction probabilities are considered for four types of potential exposures: external whole body gamma doses, beta skin doses, lung, and gastrointestinal tract doses. Particle size distributions and estimates of their distribution on the earth surface are based on APG-2 and LMSC data, respectively, although for the size ranges of interest for the last three dose categories, extrapolations are required in both cases. Much of the original stimulus for the probability approach concept was derived from the calculations of Decker with whose work many comparisons are made, recognizing the guesswork nature of many of the assumptions required for analyses of this type. Interaction effects are viewed again in the light of additional information gained by further review of the literature, particularly in the medical field for skin burn and GI tract exposures from external and internal sources. Particularly for the GI tract exposure, more work appears to be necessary to resolve questions of dose effects. Sufficient information appears to be available from weapons test data to bracket skin effects to a satisfactory extent. Similarly, the dosimetry and effects of particulate irradiation in the lung are reasonably well defined at present, and only slight improvements, if any, can be made in the whole body dose model since the major factors in this area concern the duration of exposure and separation distance. (auth)

31790 (NYO-9323) RESPIRATORY PROTECTIVE EQUIPMENT. Final Report. Leslie Silverman and William A. Burgess (Harvard Univ., Boston. School of Public Health). June 30, 1964. Contract AT(30-1)-2355. 151p.

Includes Appendices I through VIII.

A procedure was developed for use in the evaluation of respirator performance. A low toxicity aerosol, uranine, that can be detected in microquantities by fluorescence methods, was used as a tracer. Several existing types of respirators were evaluated by this method. Two self-contained positive air pressure supply respirator units were designed and tested. Design features are described. (C.H.)

31791 (ORNL-P-4) DEPOSITION OF SUBMICRON-SIZE PARTICLES IN VENTILATION DUCTS. L. P. Davis (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 18p. (CONF-555-4)

From the International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

The purpose of this study was to investigate mathematically the concentration decrease due to particle deposition phenomena in highly concentrated monodispersed aerosols (mean particle size less than 1.0 μ) flowing through ventilation ducts. It was found that, from the standpoint of removal, the decrease in concentration due to deposition on duct walls was insignificant; but, when considering contamination on the duct walls, the amount deposited, even though small when compared with the amount in the bulk stream, should not be overlooked. The rate of deposition, characterized by the deposition velocity, was calculated by using the Colburn analogy between momentum and mass transfer. Because of the significant coagulation encountered in the cases investigated, the mean particle size was found to be a strong function of the residence time in the duct. This necessitated that the deposition velocity be expressed as a function of residence time rather than as a function of particle diameter (as in the usual case). The mean diameter was expressed as a function of time and concentration combined with a mass balance over a differential volume element, and the results were integrated. The integrated equation gives a conservative estimation of the decrease in concentration to be expected when highly concentrated, unstable, submicron size aerosols are transported through ventilation ducts. (auth)

31792 (PNROO-DEV-128) ENVIRONMENTAL RADIOACTIVITY AT THE BETTIS ATOMIC POWER LABORATORY FOR THE SECOND SIX MONTHS OF 1963 AND FOR CALENDAR YEAR 1963. (Westinghouse Electric

Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 17, 1963. Contract AT(11-1)-Gen-14. 16p.

Data are presented on levels of radioactivity measured in the environs of the Bettis Atomic Power Lab., from July through Dec. 1963. Results are given from measurements of background radiation, fallout radioactivity, and gross radioactivity in liquid effluent discharged from the Laboratory. (C.H.)

31793 (PNROO-DEV-129) ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR THE SECOND HALF OF 1963 AND FOR CALENDAR YEAR 1963. (Pittsburgh Naval Reactors Operations Office, AEC). 9p.

During the second half of 1963, measurements of radioactivity were made in the Ohio River, atmosphere, and fallout in the vicinity of the Shippingport Atomic Power Station. The results of these measurements support the conclusion that the radioactive waste released by the power station into the air and into the Ohio River did not result in a significant change in the naturally occurring radioactivity in the environment. (auth)

31794 (R64SD-1) SPACE RADIATION AND THE SUPERSONIC TRANSPORT. S. P. Shen (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Jan. 1964. 72p. (AD-431156)

The significance of cosmic rays for the passengers and crew of a supersonic transport is examined in the light of existing knowledge. Both the ever-present cosmic rays from outside the solar system (galactic cosmic rays) and the occasional cosmic-ray bursts from the sun (solar cosmic rays) are considered. The absorbed dose due to galactic cosmic rays is estimated for every point in the atmosphere, i.e., for various latitudes and altitudes and for both solar maximum and solar minimum, this dose rate does not exceed 1 mrad/hr, here taken to be equivalent to 1 mrem/hr. The RBE dose due to neutrons produced in the atmospheric nuclear cascade is estimated separately for several points in the atmosphere; this dose rate similarly does not exceed 1 mrem/hr. The number of nuclear interactions (stars) in tissue is also given for several points in the atmosphere. The poorly known biological dose of these stars and of stopped cosmic-ray heavy nuclei is discussed briefly. The solar cosmic rays are then considered; this includes a discussion of their frequency of occurrence and their dose. The very rare solar-cosmic-ray events of the most intense and penetrating type can be a significant source of dose under certain unfavorable circumstances. The important question of short-range forecasting of such events so that they may be avoided where necessary by the supersonic transport is discussed. (auth)

31795 (RFP-336) SOME NEW DEVICES USED IN PLUTONIUM CONTAMINATION CONTROL. D. A. Putzier (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Aug. 30, 1963. Contract AT(29-1)-1106. 13p. (CONF-577-1)

From American Industrial Hygiene Association Annual Meeting of the Rocky Mountain Section, Albuquerque, N. Mex., Oct. 1963.

Three devices were developed for the detection of glove failures and for the control of contamination release during glove changes. The devices are the Alpha Flasher (for rapid detection of glove failures), the Downdraft Hood (a throwaway hood for use during glove change), and the Glove Change Ring. (D.L.C.)

31796 (SC-DC-64-879) HEALTH PROTECTION ASPECTS OF LASERS AND MASERS. [G. E. Tucker] (Sandia Corp., Albuquerque, N. Mex.). [May 1964]. Contract AT(29-1)-789. 16p. (CONF-586-1)

From Albuquerque Operations Office and Contractors Health Protection Conference, Kansas City, Mo., May 1964.

Biological hazards associated with lasers and masers are discussed. It is pointed out that at present the only recognized physiological effects of a laser beam is the thermal effect but other effects may be very potent. Animal experiments have shown that lasers can damage the eye at short distances. Procedures are outlined for controlling hazards from laser light. (C.H.)

31797 (TID-20819) ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA. Report for Period, July–December 1963. (Oak Ridge National Lab., Tenn.). Contract [W-7405-eng-26]. 15p.

The air and ground contamination found in both the immediate and remote environs of Oak Ridge from July to Dec. 1963 was due primarily to fallout from sources other than local plant operations. From analysis of the data presented, it was concluded that the Oak Ridge Operations contributed little to air or ground contamination in the neighborhood of the area controlled by the Atomic Energy Commission. While some radioactivity was contributed to the Clinch River by the release of low-level radioactive liquid wastes from local operations, the resulting concentrations in the river were well below the maximum permissible concentration for populations residing in the neighborhood of a controlled area. (auth)

31798 (TID-20820) KNOLLS ATOMIC POWER LABORATORY. Semiannual Environmental Monitoring Report, July–December 1963. Volume 5, Number 2. (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1964. Contract W-31-109-eng-52. 12p.

Results are reported from measurements of environmental radioactivity conducted by the Knolls Atomic Power Laboratory at both the Knolls Site and the West Milton Site from July through Dec., 1963. Small amounts of radioactive materials are released both to the atmosphere and to two surface streams in the area. All liquid waste and exhaust air systems are carefully and continuously monitored. As a result of the environmental monitoring program, it was concluded that the operations at these installations did not adversely affect the radioactivity levels of the local environment during this period. (C.H.)

31799 (TID-20821) SURVEY OF ENVIRONMENTAL RADIOACTIVITY. [Period Covered]: July–December 1963. (Minnesota. Dept. of Health, Minneapolis and Rural Cooperative Power Assn., Elk River, Minn.). Jan. 1964. Contract AT(11-1)-651. 36p.

Data are presented on the radioactivity in samples of air, precipitation, surface water, and milk collected in the vicinity of the Elk River Power Reactor, Minn., from July through Dec. 1963. (C.H.)

31800 (UCRL-7903) THE SIGNIFICANCE OF BERYLLIUM SURFACE CONTAMINATION TO HEALTH. Jerry J. Cohen and Ross N. Kusian (California. Univ., Livermore. Lawrence Radiation Lab.). May 27, 1964. Contract W-7405-eng-48. 9p. (CONF-555-3)

From International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

Surface contamination with Be becomes a hazard to health only when the potential exists for resuspension in air in enough quantity and for enough time to exceed the

prescribed standards for airborne exposures. There are several factors governing the rate and nature of resuspension phenomena. These factors include the quantity and properties of the particular Be compound causing the contamination; the nature of the surface; activities in the vicinity; ventilation in the area which might affect the dilution of resuspended particles; and the presence of other control measures such as respiratory protection and use of wet methods. Experience has shown it to be extremely difficult to correlate the amount of Be surface contamination to the potential health hazard in a meaningful manner. Because of the many variables affecting potential Be exposures due to surface contamination, it is perilous to attempt expression of its significance quantitatively. Generally, it has been found that the problem is minimal and can be easily controlled by exercising good judgment based upon consideration of pertinent factors governing resuspension, and a knowledge of the nature of Be toxicity. (auth)

31801 (JPRS-25068) OCEANOGRAPHIC RESEARCH: EQUIPMENT AND TECHNIQUES. Translated from Okeanologiya, 4: 213-353; 359-61(1964). 79p. (OTS-64-31473)

Separate abstracts were prepared on two papers of this report. Other topics discussed include a comparative study of certain biochemical aspects of the Black Sea, Caspian Sea, and Sea of Azov; problems in the selection of vessels for oceanographic research; methods for marine microbiology; and methods for the determination of primary production in the ocean. (C.H.)

For abstracts of individual papers see: 31757 and 31919.

31802 (JPRS-25214) PROTECTING FOOD AND WATER AGAINST CHEMICAL-BIOLOGICAL-RADIOLOGICAL ATTACK. V. Ya. Kovalenko. Translated from p.3-64 of Kak Zashchitit- Vodu i Prodovol'stvie ot Radioaktivnykh, Otraviyayushchikh Veshchestv i Bakterial'nykh Sredstv." Medgiz, 1963, Moscow. 58p. (OTS-64-31541).

The properties of radiological, chemical, and bacteriological warfare agents are reviewed from the viewpoint of their contaminating action on food products, forage, and water supplies. Methods for the protection and decontamination of food products, forage, and water supplies are discussed for home conditions and conditions where technological equipment is used for large-scale operations. Various types of packaging material are evaluated for their protective effects against the three types of noxious agents. Monitoring methods and protective clothing are discussed, and methods are outlined for decontamination, degassing, and disinfection of various foodstuffs, raw materials, forage, and water supplies. The effectiveness of various decontaminating agents and methods are evaluated. Methods for the destruction of provisions and forage that do not yield to decontamination are also described. (C.H.)

31803 (JPRS-25250) PROTECTION OF GRAIN PRODUCTS FROM RADIOACTIVE, CHEMICAL AND BACTERIAL SUBSTANCES. V. L. Averbuch and I. Z. Berlin. Translated from p.26-40 of "Kak Zashchitit-Khlebo Produkty ot Radioaktivnykh, Khimicheskikh Veshchestv i Bakterial'nykh Stredstv," Moscow, 1963. 14p. (TT-64-31555)

Procedures are discussed for the protection of grain and grain products from contamination by radioactive, chemical, and bacteriological substances. The procedures include the protection of grain during temporary storage at places of production, protection during transportation, the hermetic sealing of grain storage elevators, the construction of grain storehouses to prevent contamination of stored grain, protection at flour mills and processing plants, protective packaging, and the protection of packaged grain and grain products during storage. (C.H.)

31804 (NP-tr-1153) ACCIDENTS AND BREAKDOWNS AT NUCLEAR INSTALLATIONS. U. Schulze. Translated by O. S. Whitston (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from report KFK-68. Nov. 1961. 63p.

Data are summarized on 60 nuclear accidents reported from eight countries from 1945 through 1961. Only accidents that involved radiation hazards due to breakdowns in reactors, critical assemblies, processing plants, and accelerators are included. Data are included on the nature of the accident, amount of energy liberated, duration of work stoppage, damage to equipment, cost, extent of contamination, and personal injuries. Bibliographic references are included. (C.H.)

31805 PRINCIPLES AND LAWS OF THE REGULATION CONCERNED WITH THE PROTECTION AGAINST IONIZING RADIATION. A. Lafontaine. Acta Clin. Belg., 17: 313-33(1962). (In French)

The biological effects of radiation are reviewed. Governmental regulations concerning the use of radioactive materials in medicine and by industry in Belgium are reviewed. Recommendations issued by Euratom and the International Atomic Energy Agency concerning radiation protection of the population are discussed. (C.H.)

31806 RADIOCHEMICAL ESTIMATION OF NEUTRON DOSES ASSOCIATED WITH ATOMIC EXPLOSIONS AT HIROSHIMA AND NAGASAKI. Noritaka Onishi (Meiji Coll. of Pharmacy, Japan). Bull. Meiji Coll. Pharm., No. 2, 18-22(Dec. 1963). (In Japanese)

A method of radiochemical estimation of neutron doses associated with atomic explosions at Hiroshima and Nagasaki was investigated. A small quantity of cobalt contained in iron goods or iron materials bombarded at that time was estimated, and the activity of ^{60}Co bombarded at that time was estimated. The activity of ^{60}Co that seemed to have been produced by the $^{59}Co(n,\gamma)^{60}Co$ reaction in the atomic explosions was determined, and the radioactivity per unit mass of cobalt was found. From these values, neutron doses received by the above-mentioned samples were calculated and estimated. (auth)

31807 HEALTH ASPECTS OF IONIZING RADIATION. Norman Simon (Mt. Sinai Hospital, New York). Diseases Nervous System, 24: No. 4, 49-54(Apr. 1963).

A review of the nature and biological effects of radiation is presented, and the hazards to which man is exposed from the three principal sources of radiation (natural background both external and internal, medical use of x rays, and fallout) are assessed. It is concluded that the main late effects of radiation are life shortening, carcinogenesis, and sterility. Studies of long-term survivors who had received radiation for cancer of the uterine cervix are reviewed. The data for more than 70,000 patient-years of exposure showed the incidence of leukemia to be essentially the normal incidence of leukemia in women of that age group. Problems involved in the statistical study of patients previously treated with radiation in order to determine an incidence of leukemia which may limit the accuracy and value of the results, are discussed. It is suggested that the difference in the distribution of radiation in the spine and bone marrow could play a major role in the difference be-

tween the incidence of leukemia in patients treated for spondylitis and for cancer of the cervix. After consideration of medical and fallout sources of human radiation exposure, it is concluded that natural background still provides most of the radiation exposure to man, and that man has endured this level of radiation throughout his development. (OTS)

31808 EXPOSURE DOSE OF RADIATION WORKERS IN KYUSHU UNIVERSITY. Kenji Takeshita, Shigeaki Aoki, and Masato Aramaki (Kyushu Univ., Fukuoka, Japan). Fukuoka Igaku Zasshi, 54: 1-7(Jan. 1963). (In Japanese)

Measurements of radiation exposure doses were made for 328 occupationally exposed persons, using x-ray film dosimetry, since April 1961. X rays of 45 kv and ^{226}Ra were the most frequent sources of exposure. Less than 5% of the workers were exposed to more than the acceptable limit of 800 mrem per two months according to these measurements. (BBB)

31809 SYSTEMATIC X-RAY EXAMINATIONS AND RADIATION HAZARDS. J. Rémy and H. Chéradame. Gaz. Med. France, 70: 2993-3003(1963).

One radiographic exposure a year entails a gonadal dose equal to $\frac{1}{150}$th of the natural radioactivity. It appears, therefore, that the somatic and genetic risks of radiological examination are minimal. Nevertheless, the number of radioscopies should be reduced to a minimum and the aperture of the field should be as narrow as possible. Whenever feasible, radiography should be done which, when carried out with a maximum of protection, has negligible risks in comparison with its diagnostic value. In 1962 examination of 58,000 subjects led to discovery of 225 cases of tb, a percentage of 0.387%. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964).

31810 MASSACHUSETTS PREPARES FOR MASS EMERGENCY. Hospitals, 37: 49-53(Dec. 16, 1963).

A civil defense program is described whereby Massachusetts hospital personnel and allied health workers take intensive training in disaster planning at a four-day workshop. Although the training program's main emphasis is on familiarizing the students with the crated hospital's supplies and equipment, and training them to set it up and operate it swiftly and efficiently, the program has broader applications. It provides grounding in mass casualty management and instructions in civil defense planning that can be adopted by individual hospitals. Instruction is given in shelter management, handling mass casualties, methods for developing radiological monitoring capabilities within the hospital and the community, and operation of radiological instruments. It is suggested that this Massachusetts project may become the prototype program for emergency hospital training centers in the other 49 states. (BBB)

31811 PLANNING FOR RADIATION ACCIDENTS. R. A. Love (Brookhaven National Lab., Upton, N. Y.). Hospitals, 38: 50-6(Feb. 16, 1964). (BNL-7364)

A radiation decontamination unit and the equipment and supplies needed for its operation are described. The question of stockpiling blood and other materials for the treatment of the irradiated patient are also discussed. (auth)

31812 MEASUREMENT AND CONTROL OF AIR CONTAMINANTS IN ONTARIO URANIUM MINES. G. R. Yourt (Rio Tinto Mining Co., Toronto). Ind. Med. Surg., 33: 222-9(Apr. 1964).

New techniques and instruments for the control and measurement of air contaminants are described, with emphasis on the basic principles of dust control: suppression at the source, confinement, and dilution and removal by clean air. Sources of dust (60% quartz) are classified. Methods for determining the size of dust particles are outlined. The problems arising from exposure of miners to U, Ra, and their decay products are also considered. Features for control of radioactivity in the Nordic U mine are discussed. (TCO)

31813 THE RADIATION HAZARD. Edward Teller (Univ. of California, Berkeley). J. Iowa State Med. Soc., 53: 629-33(Sept. 1963).

Hazards of radiation, particularly from fallout, are discussed, and it is concluded that such hazards are insignificant. (BBB)

31814 THE FIELD AMBULANCE IN NUCLEAR BATTLE. D. L. Nicholls. J. Roy. Army Med. Corps., 107: 199-204(Oct. 1961).

The problems expected to be encountered in collecting casualties during tactical warfare with nuclear weapons are considered, and the organization of the British army, particularly the medical services, for waging nuclear battles is outlined. Proposals for deployment of medical units to move closely conform to conditions expected to exist during use of tactical nuclear weapons are offered. (OTS)

31815 MRMU IN CASE OF RADIOACTIVE TROUBLE. David G. Jones (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Mech. Eng., 86: 29-31(May 1963).

The development of mobile remote manipulator units (MRMU), a system of vehicles designed to operate in radiation environments that would be detrimental or lethal to man, is described. The vehicles can be transported by air and dropped on the target. Complete remote control is realized by using microwave transmission of vehicle control and communication signals, and because of this the heavy lead shielding that would be necessary for operator protection is eliminated from the vehicles. Six recovery vehicles are described: surveillance, land-clearing, lifting and carrying, utility, tool handling, cask-hauling, and command-control vehicles. Uses of each are discussed. (M.C.G.)

31816 CONTAMINATION OF FOODS BY FALLOUT. R. H. Wasserman (Cornell Univ., Ithaca, N. Y.). N. Y. State J. Med., 60: 3857-62(Dec. 1, 1960).

Mechanisms by which fallout fission products are incorporated into the food chain of man are reviewed. It is pointed out that, although the main vector of fission products from nuclear detonations to man is food, direct inhalation and subsequent absorption from the alveolar tissue or percutaneous absorption may become primary routes of entry. Ways in which growing plants accumulate radioactive fission products and transmit them to man, either directly by the consumption of contaminated vegetables, cereals, grains, and fruits, or indirectly through the consumption of contaminated animal products are described. Emphasis is placed on the movement of ^{90}Sr and ^{137}Cs through the food chain. Estimates of the body burden and radiation hazard from these fission products are presented. Agricultural and chemical methods of reducing the concentration of fission products in foods are considered briefly. (C.H.)

31817 AN ESTIMATION OF PAST EXPOSURE DOSE TO X-RAY WORKERS IN JAPAN. Takashi Kitabatake (Nagoya City Univ., Japan) and Shunzo Okajima. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1151-8(Jan. 1964). (In Japanese)

Radiation dose received by x-ray workers is considered to be influenced or dominated by the following factors: (1)

attention to x-ray protection. (2) sensitivity of x-ray films, (3) sensitivity of intensifying screens, (4) protection of control board, (5) protection of x-ray tube, and (6) quantity of x-ray work. When any of these factors were poor, the radiation dose received by x-ray workers would be increased in proportion to the poorness of the factors. For example, the sensitivity of x-ray films before 1954 was about half of present sensitivity, therefore an x-ray dose about twice the present level was required for obtaining the same density on the film. This may lead to twice the exposure dose to x-ray workers before 1954. Similar considerations lead to numerical values of poorness of other factors in the past. The results of dose estimations are as follows: 0.45 r/yr at present, 2.25 r/yr in 1954 to 1957, 13.5 r/yr in 1946 to 1956, 135 r/yr in 1941 to 1945, 405 r/yr in 1936 to 1940, 900 r/yr in 1931 to 1935, 1350 r/yr in 1927 to 1930, 1800 r/yr in 1922 to 1926, and 18000 r/yr before 1921. (auth)

31818 RADIATION ACCIDENT. INJURY OR FEAR. W. D. Norwood (General Electric Co., Richland, Wash.). Northwest Med., 243-4(Apr. 1964). (HW-SA-3438)

Since extreme fear is often present in an employee who has had a possible acute exposure to ionizing radiation, the physician should quickly evaluate the condition of the patient by careful attention to the history, signs, and symptoms. This will allow adequate timely treatment, if necessary, and also facilitate prognosis. Followup studies, to determine the dose of radiation, should be made as an assistance in handling the case and for use in any necessary work limitation. This dose should be added to the cumulative radiation exposure record of the employee. If long delayed effects are considered possible, appropriate medical checks should be made at intervals. (auth)

31819 RADIATION PROTECTION VIA THE PINHOLE CAMERA. Albert G. Richards (Univ. of Michigan, Ann Arbor). Oral Surg. Oral Med. Oral Pathol., 13: 953-63 (Aug. 1960).

A pinhole camera which simultaneously produces photographs and roentgenograms of any object which reflects light and emits secondary x-radiation is described. Photographs and roentgenograms of a phantom head, obtained with the pinhole camera and an x-ray machine, show the sources of secondary radiation which function when an examination of the patient's teeth is made by means of x radiation. A method is suggested for reducing the unnecessary exposure of both the patient and operator to scattered, secondary radiation. Other measures suggested for the protection of the dental patient against needless exposure to x-radiation are: use of high-speed film; full development of film; limitation of the diameter of the x-ray beam to the smallest practical size by means of a lead diaphragm; passing of the x rays through a filter to remove the nonuseful radiation from the beam; operation at high voltages; and use of an extended distance between the x-ray tube and the patient's face. Suggestions are also made for minimizing exposure to dental personnel during radiography. (BBB)

31820 A METHOD FOR REDUCTION OF SCATTERED RADIATION EXPOSURE FROM METALLIC DENTAL FILLINGS. R. Holtzhauer, A. Unverricht, and F. Schwabe (Friedrich-Schiller-Universität, Jena, Ger.). Radiobiol. Radiother., 3: 615-19(1962). (In German)

When the region of the oval cavity is irradiated by high-energy sources such as in telecobalt therapy, mucosal ulcers may be produced by radiation scattered from metallic false teeth and/or fillings. The intensity of the scattered radiation was studied using normal x-ray dental films as dosimeters. A ^{60}Co unit and a 100-kv x-ray apparatus were used as radiation sources. The primary radiation was directed through a sandwich of two dental films arranged in parallel with 1-mm metal plates of Pb, Cu, and Al inserted between them. Primary radiation penetrated the first film, producing scattered radiation from the metal plates in proportion to the atomic numbers. The second film was exposed only to the radiation unabsorbed by the metal plates and the scattered secondary radiation. When the films were developed the area adjacent to the Pb plate was darkened more by the scattered radiation than the area adjacent to the Al. Evaluation of the backscattered radiation showed that with a telecobalt source the dose, from backscattered radiation, was increased 53% by Pb, 21% by Cu, and 7% by Al. Most fillings used in dental repairs correspond to this range of metals. Secondary electrons from these metals penetrate for a distance of ~3 mm into the cheek, and it is understandable that mucosal damage can result. It was not possible to measure the backscattered radiation when 100-kv x rays were used, and it can be assumed that scattered radiation from this source is absorbed in the thin epithelial layer of the oral mucosa, because no injuries are observed. Measurements were also taken after a 3-mm-thick polymethylacrylic acid ester plate was placed between the first film and the metal plates. This was sufficient to completely absorb the radiation backscattered from the metal plates. When hard radiation is administered, this type of absorbent shield should be used for backscattered electrons. Metal fillings should be removed or shielded with caps made of plastic material. (BBB)

31821 DOUBLE PROTECTION HOOD FOR HANDLING RADIOACTIVE SUBSTANCES. I. Szantai. Rev. Chim. (Bucharest), 15: 161-2(Mar. 1964).

A doubly protecting hood for handling radioactive substances is described, which offers, in addition to the protection offered by the screening and mechanical performance of operations inside the hood, the following advantages: ease of dismantling and decontamination; minimization of manual operations in the interior; complex range of operations; and telemotion device capable of moving several containers at once. (OTS)

31822 THE DECONTAMINATION OF SURFACES AND OBJECTS CONTAMINATED BY RADIOACTIVE SUBSTANCES. II. EXPERIMENTAL PART. Tr. Cheorghiu, D. Serban, T. Vlad, and C. Licaret. Rev. Chim. (Bucharest), 15: 218-19(Apr. 1964).

The decontamination of various substances contaminated with one of 11 radioactive materials was tested. Decontaminating agents tested included 22 common chemicals, of which the most effective were 5% HCl, 2% ammonium citrate, or a mixture of 3% HCl with 2% sodium citrate. Direct vigorous rubbing was more effective than immersion, and repeating the treatment did not improve the results. Best decontamination was obtained for plastic sheets (over 90%), followed by linoleum, tin-plated sheets, glass, aluminum, and black iron sheet. The results also depended on the nature of the contaminating substance. (OTS)

31823 PRESENT STATUS OF THE DISTRIBUTION OF IONIZING RADIATIONS AND THE HEALTH OF PARTICIPATING WORKERS IN OUR INDUSTRIAL CIRCLE. REPORT I. Masahiko Ohira and Yoshio Mochizuki (Okayama Univ., Japan). Sangyo Igaku, 6: 754-65(Jan. 1964). (In Japanese)

Three hundred and seventy four industrial enterprises listed in the Department of Labor as handling ionizing radiations were investigated by means of questionnaires.

Answers were received from 229 radiation-handling works involving 1,742 workers. Among 824 sources x-ray equipment for nondestructive inspection ranked at the top and radioactive substances, industrial gamma-ray apparatus, x-ray diffraction apparatus, accelerators, and nuclear reactors followed in that order. In industrial classifications, the order was transportation machine makers (mainly shipbuilding), electric equipment makers, the chemical industry, steel and nonsteel metal industries. Exposure doses were investigated in those dealing with one kind of radiation source. Calculating for a year, the doses were: below (and including) 10 mrem, 53.5%; under 500 mrem, 33.9%; under 1000 mrem, 8.3%; under 5000 mrem, 3.9%; and above 5000 mrem, 0.4%. The measurement was taken by a film badge method. It seldom exceeded the exposure doses recommended by ICRP. Pocket dosimeters showed almost the same, with a tendency to show a slightly higher dose compared with the film badge method. Exposure dose took the order of industrial x ray, industrial gamma ray, medical x ray, and medical gamma ray. In the industries, there was a tendency for the exposure dose to be larger in small industries. (auth)

31824 THE RADIATION HAZARD OF SPACE. Frank L. Bouquet, Jr. (Lockheed-California Co., Burbank). Space/Aeron., 39: No. 5, 72-7(May 1963).

Available data are summarized on radiation hazards to man during space flight. It is pointed out that the hostility of space manifests itself primarily in the form of high-speed meteoroids and of penetrating, highly energetic nuclear radiation. This radiation may be either a natural product of the space environment itself or artificially induced by man as a result of high-altitude nuclear explosions or intense neutron and γ radiation fields emitted by nuclear spacecraft power plants. Other environmental phenomena in space include a high vacuum, thermal energy from the sun, x rays, γ rays, ultraviolet radiation, highly energetic secondary nuclear particles, solar-flare protons, geomagnetically trapped radiations, and miscellaneous nuclear radiations. The characteristics, location, and energy levels of the major radiations in space are discussed, and shielding methods and materials are considered. (C.H.)

31825 DESIGN OF A MAZE FOR RADIATION PROTECTION. Masaaki Sakuta (Taisei Construction Co., Ltd., Japan). Trans. Architect. Inst. Japan, No. 89, 350(Sept. 1963). (In Japanese)

There are two types of doorways for an irradiation room, namely, a shelter and a maze. The latter is used more often in irradiation rooms for commercial or industrial uses. The protective effect of a maze is considered for gamma rays. This effect is described by the ratio of the dose rate at the doorway to that at a point 1 m from the source. To calculate this ratio the attenuation rate computation formulas are presented in the form of a table. The correction coefficient obtained by experiments is also introduced. In addition, the use of the pocket effect at a corner to save the area of a maze is shown by an example. (NSA of Japan)

31826 THE PHYSICIAN AND RADIATION FALLOUT. C. M. G. Buttery. Virginia Med. Monthly, 90: 567-72 (Nov. 1963).

Medical data relating to the effects of fallout and measures that can be taken to protect the population against it are outlined. Estimates are made of the expected radiation doses that might be received from fallout by survivors of a thermonuclear war, and these are compared with the recommendations of the International Commission on Radiological Protection that suggest that the maximal amount of radiation absorbed during thirteen 40-hr weeks should be 0.3 rem/week, which is the equivalent of 306 mr of x or γ rays. It is suggested that it will probably take 6 to 8 weeks for radiation fallout outside shelters to decay to this level, or ~1000 hr. Shielding requirements for shelters are discussed. The Western Piedmont is determined to be the area of Virginia likely to receive the least fallout in event of a nuclear attack. The main types of shelters being constructed are described and discussed. Suggestions for equipping fallout shelters with medical and dietary items, in addition to the standard, staple items, are made. Prophylaxis and treatment of radiation sickness are discussed, and some protective measures to prevent fallout contamination of food and water are proposed. (OTS)

31827 RADIATION PROTECTION IN NUCLEAR REACTOR FUEL FABRICATION PLANTS. NATURAL (OR NORMAL) AND ENRICHED URANIUM, THORIUM, AND PLUTONIUM. ASA No. N7.2-1963. (Approved July 8, 1963). New York, American Standards Association, Inc., 1964. 36p.

Minimum requirements are presented for a radiation protection program in reactor fuel fabrication plants, using as a guide the permissible limits set forth by the National Committee on Radiation Protection. Radiation protection features that should be incorporated in the design of installations for the fabrication of nuclear fuel and practices that should be followed to control radiation exposure during the operation of these facilities are set forth. All manufacturing or processing steps starting with the refined nuclear fuel material in any physical form and finishing with a complete reactor core that involve the handling of natural U, ^{235}U-enriched U, Th, or Pu are considered. Methods for carrying out an overall radiological protection program are appended. (C.H.)

31828 RADIATION PROTECTION. RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ICRP PUBLICATION 6. (As Amended 1959 and Revised 1962). A Pergamon Press Book. New York, The Macmillan Company, 1964. 75p. $3.75.

Recommendations are made for maximum permissible radiation doses for individuals and for population groups. The basis for these recommendations is discussed. (C.H.)

31829 RADIATION PROTECTION. RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ICRP PUBLICATION 4. REPORT OF COMMITTEE IV (1953-1959) ON PROTECTION AGAINST ELECTROMAGNETIC RADIATION ABOVE 3 Mev AND ELECTRONS, NEUTRONS AND PROTONS. (Adopted 1962, with Revisions Adopted in 1963). A Pergamon Press Book. New York, The Macmillan Company, 1964. 49p. $3.25.

Recommendations are presented on maximum permissible radiation exposures to electrons, electromagnetic radiation with quantum energies above 3 Mev, and neutrons and protons with energies up to 1000 Mev. All doses are expressed in rems, which implies that the absorbed dose, expressed in rads, should be multiplied by an appropriate weighting factor. (C.H.)

31830 SAFE HANDLING OF RADIOACTIVE MATERIALS. Recommendations of the National Committee on Radiation Protection. NCRP Report No. 30. National Bureau of Standards Handbook 92. (National Bureau of Standards, Washington, D. C.). 1964. 10p. $0.40(GPO).

Criteria are set forth for the safe handling of radioactive materials. The main considerations of safety gained from research and practical experience to date are included in

this handbook that supersedes NBS Handbook 42, "Safe Handling of Radioactive Isotopes," issued in 1949. It is recommended that this handbook be used in conjunction with NBS Handbook 59, "Permissible Dose from External Sources of Ionizing Radiation," and NBS Handbook 69, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure." (C.H.)

31831 REGULATING CLINICAL APPLICATIONS OF RADIOACTIVE DRUGS. REPORT OF THE AD HOC COMMITTEE ON REGULATION OF RADIOACTIVE PHARMACEUTICALS. New York, Atomic Industrial Forum, Inc., 1964. 26p.

Governmental regulations are reviewed that cover the administration of radioactive drugs to human beings for the diagnosis or treatment of disease. The two federal agencies most prominently involved in the regulation of human use of radioactive drugs are the Atomic Energy Commission and the Food and Drug Administration. The regulatory programs were reviewed to determine whether they adequately protect the public health and safety without hindering medical research and the development of a private radioactive drug industry. Certain changes in regulatory procedures are recommended and studies to provide additional criteria are suggested. (C.H.)

31832 RADIOACTIVITY SURVEY DATA IN JAPAN. NUMBER 1. (Japan. National Inst. of Radiological Sciences, Chiba). Nov. 1963. 35p.

A nationwide radioactivity sampling program and survey project in Japan has been in effect since 1957 under the direction of the Japan Atomic Energy Commission. Systematic surveys were conducted on the levels of radioactivity in samples of air, precipitation, dust, drinking water, foods, soil, sea water, marine organisms, and the stratosphere. Radioactivity levels in the human body were determined by the analysis of urine, bones, internal organs, and tissues collected at various locations. Related studies included an evaluation of the exposure of the population as a whole, infants, and other specific groups to environmental radioactivity; research on radioecology with emphasis on the contamination and decontamination of the food chain; the biological behavior and metabolism of fission products, with emphasis on ^{90}Sr and ^{137}Cs; and the transport of fission products in soil and water. Cumulative data are tabulated. The status of the survey project in Nov. 1963 is reviewed. (C.H.)

31833 VACUUM CLEANER WITH CYCLONE SEPARATOR (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1059)

This package contains 1 drawing. For a listing of this title, see the Engineering Materials List (TID-4100). This vacuum cleaner is used to pick up radioactive material. Particulates are removed from the air-stream with a small cyclone separator, which is followed by a highly efficiency filter. The vacuum cleaner employs an Electrolux motor and fan. A dust collector is connected to this equipment by a 1.5-in. copper tube. The fan, motor, and filter are contained in a fir-plywood box. The equipment needs a space 20 in. long × 9.69 in. wide and 23.75 in. high. (M.C.G.)

31834 THE RADIATION HAZARD AT THE TOP OF THE ATMOSPHERE. W. R. Sheldon and D. L. Dye (Boeing Co., Seattle). 43p. (CONF-574-1)

From 5th Conference on Applied Meteorology, American Meteorological Society, Atlantic City, Mar. 1964.

The radiation environment at the top of the polar atmosphere is described. The nucleonic component of the galactic cosmic radiation and solar flare particle events are emphasized. For purposes of the current analysis, this is the same radiation environment that would be encountered inside a space vehicle with walls a few grams per square centimeter thick, on a mission in the vicinity of the earth but outside of the magnetosphere. The resulting radiation hazard is evaluated both in terms of dose in rads and the fraction of cells killed per hour. These values are compared to similar calculations at 47 g/cm^2 of atmosphere (70,000 feet) and 230 g/cm^2 (36,000 feet). (auth)

31835 METHOD FOR THE REMOVAL OF RADIOACTIVE CONTAMINATIONS FROM GASEOUS COOLANTS OR BLANKETING GASES OF NUCLEAR REACTORS. Wilhelm Lehmer and Wolfgang Baldus (to Gesellschaft für Linde's Eismaschinen AG). German Patent 1,166,388. Mar. 26, 1964. Filed Dec. 12, 1958.

Radioactive contaminations are removed with the help of a decontaminating device using low temperatures. The cold is transferred indirectly from the cold agent to the decontaminating device by an intermediate gas stream. The intermediate gas stream may be part of the gaseous coolant flowing out of the decontaminating device. (Gmelin Inst.)

INSTRUMENTATION

General

Refer also to abstract 31526.

31836 (ASD-TDR-63-697) RADIATION PHYSICS: ITS IMPACT ON INSTRUMENTATION. Rudy C. Beavin (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Sept. 1963. 18p. (AD-428970; CONF-445-2)

From Aeronautical Systems Division 1963 Science and Engineering Symposium, Wright-Patterson AFB, Ohio, Sept. 1963.

Presented in an argument for exploiting radiation physics for the solution of problems in instrumentation. A brief review is given of basic physics connected with radiation. Several problems in the flight control area are stated and possible solutions presented using radiation physics concepts. Three of these problems, low-altitude altimetry, high-altitude altimetry, and fuel mass measurement, are examined in detail and experimental and analytical results given. A program philosophy and the establishment of an in-house experimental facility for exploitation of radiation physics are also reported. (auth)

31837 (HW-80271) A REFERENCE SYSTEM FOR THE EVALUATION AND CALIBRATION OF MICRO-DISPLACEMENT READOUT SYSTEMS AT TEMPERATURES TO 500 C. J. C. Spanner, B. B. Brenden, and W. L. Nicholson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT(45-1)-1350. 28p.

The basic reference system consists of several pieces of precision readout and positioning equipment, a high-temperature test chamber, and a specially designed linkage system. The case temperature of the transducer under calibration is maintained constant to within ±0.5°C for temperatures to 500°C. A quartz and Invar Linkage system provides a minimum expansion method of coupling linear motion, through a heat shield, from the readout equipment to a transducer located in the test chamber. The reference system is periodically calibrated in the plant metrology laboratory and a basic reference system precision of ±0.3% or better for operational ranges from 0.004 to 0.500 in. was established. Calibration data are reduced using a 7090 digital computer. Computer output is in the form of numerical coefficients for statistically generated calibration curves plus a set of quality figures including precision, zero drift, and linearity. Through the use of programmed statistical cross-correlation methods, a continuous self-evaluation of the reference system is obtained, in addition to the calibration information required for readout system evaluation. The system was developed as part of a program for testing Zircaloy-2 in-reactor. (auth)

31838 (HW-81955) THE MEASUREMENT OF ULTRASONIC TRANSDUCER CHARACTERISTICS. M. F. Zeutschell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1964. Contract AT(45-1)-1350. 38p.

Equipment and techniques developed for measuring the characteristics of ultrasonic transducers for use in the USAEC/AECL program for inspection of fuel element sheath tubing are described. Transducer variables such as frequency, sensitivity damping, beam size, beam shape or symmetry, and focal point were measured. (R.E.U.)

31839 (INSJ-63) INS MASS SPECTROMETER. A NEW MASS SPECTROMETER. Mitsuo Sakai (Tokyo Univ. Inst. for Nuclear Study). Nov. 14, 1963. 11p. (CONF-578-1)

From Conference on the Physics of Electro-magnetic Separation Methods, Orsay, France, July 1962.

The application of the sector-type double-focusing principle to mass spectrometers was investigated. A new geometrical setting with excellent focusing properties was used. After theoretical considerations, the design and performance (using water and Xe isotopes) of the new mass spectrometer are described. (D.L.C.)

31840 (KFK-187) LANGSAME KOINZIDENZSTUFE MIT KONTINUIERLICH EINSTELLBARER VERZÖGERUNGSZEIT UND KOINZIDENZAUFLÖSEZEIT. (Slow Coincidence Stage with Continuous Adjustable Delay Time and Coincidence Resolving Time). W. Bauer (Kernforschungszentrum, Karlsruhe, Germany). Nov. 1963. 11p.

A coincidence stage is described that unites the continuous adjustability of monovibrator circuits with the stability of circuits with delay relays. The block diagrams of the coincidence stage, time elements, units of the IF circuit, and the actual coincidence stage (diode and gate type) are given and discussed. The characteristics of the instrument are tabulated. (J.S.R.)

31841 (MIT-2079-1) THERMAL CONDUCTANCE OF METALLIC SURFACES IN CONTACT. APPARATUS AND EXPERIMENTAL PROCEDURE FOR CONTACT RESISTANCE MEASUREMENT IN VACUUM. Progress Report, September 1963–June 1964. M. Yovanovich and John Jewett Henry (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.). June 1, 1964. Contract AT(30-1)-2079. 27p.

The design and operation of an apparatus for measuring contact resistance for a variety of conditions (high temperature, heat flow reversal, vacuum to 10^{-6} torr, and inert gas) are described. The problems associated with conducting the above-mentioned tests and the procedures used in carrying them out are described. (N.W.R.)

31842 (NYO-2910-4) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 16, April 1–May 31, 1964. (Aeroprojects, Inc., West Chester, Penna.). June 1964. Contract AT(30-1)-2910. 11p.

Work on the fabrication of all parts for the ultrasonic molten salt level detector for MSRE is nearing completion, as is the construction of the electronic apparatus. A new acoustic system is designed for the measurement of temperature by means of ultrasonics. Careful attention is paid to the elimination of all possible causes of standing wave systems. (auth)

31843 (NYO-2910-3) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bi-Monthly Progress Report No. 15, February 1–March 31, 1964. (Aeroprojects, Inc., West Chester, Penna.). Apr. 1964. Contract AT(30-1)-2910. 14p.

A complete set of design and assembly drawings for the molten salt level detector is presented. Work on the parts has begun. Attempts were unsuccessful to measure high temperature using a molybdenum acoustic transmission line in conjunction with a steel driving system and termi-

nation. Work on an improved design, eliminating standing waves, is continuing. (auth)

31844 (RT/EL(64)-2) UN NUOVO TIPO DI AMPLIFICATORE OPERAZIONALE. (A New Type of Operational Amplifier). F. Fioroni, R. Marconero, and G. V. Pallottino (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Jan. 1964. 23p.

The design criteria and the main characteristics of an operational transistorized amplifier with thermal drift between 3 to 15 $\mu V/°C$ and of open loop gain equal to 20×10^6, are described. The amplifier uses no chopper and the input stage employs pairs of silicon planar transistors having very close characteristics and with high current gain even at low levels of bias current. (auth)

31845 (SCL-TM-64-77) A MODULAR PRINTED CIRCUIT LABORATORY. E. E. Alford (Sandia Corp. Livermore Lab., Livermore, Calif.). July 1964. Contract [AT(29-1)-789]. 10p.

A compact modular laboratory for fabricating etched circuit boards is described. Pictures are given. (R.E.U.)

31846 (UCRL-7766) AN IMPULSE ACCELEROMETER. William E. Nelson, Jr., and G. Wayne Brown (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 12, 1964. Contract W-7405-eng-48. 30p.

Contemporary accelerometers fall into two general categories: mechanical deformation and electronic transducer. The first type can be small and rugged but it has the disadvantage of reading out only an acceleration level, which must be regarded as a "figure of merit" depending on the relation between the dynamic response of the accelerometer and the nature of the input excitation. The electronic transducers are capable of accurate acceleration input monitoring, if properly used, but require conditioning and readout equipment for which there often is no space or power. An accelerometer, which offers some of the advantages of each of the categories, is described. It is relatively small and rugged and requires no conditioning or readout equipment during operation. Readout consists of an "equivalent" square wave with an acceleration level and pulse interval time. The instrument can be utilized to measure square wave accelerations directly, or, if a wave shape is known, its output data can be mathematically transformed to the type of "g-signature" actually measured. The particular geometry discussed is shown to be useful for acceleration ranges of 100 to 250 g's and 150 to 450 g's. These ranges can be extended by modification of certain design parameters that are discussed. (auth)

31847 (UCRL-7858) EXPONENTIAL SIGNAL RATE-OF-RISE MEASUREMENT INSTRUMENT. Gale Holladay, Ervin Behrin, and Donald Campbell (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 6, 1964. Contract W-7405-eng-48. 26p.

An instrument for detecting the multiplication rate α of an increasing exponential signal of the form $Ee^{\alpha t}$ is described. Accuracies of 5% are obtained for α over the range 10 to 110 generations per microsecond. The input signal is split between attenuator and delay-inverter arms of a bridge network and then recombined by addition in the bridge output. Assuming a constant α input, the bridge output is a function of the attenuation, delay, and instantaneous input amplitude. The electronic circuitry samples and stretches the bridge output when the input signal reaches a fixed voltage level. The resulting output is a known function of α. (auth)

31848 A RADIATION-USING, SNOW-FALL TELEMETER. Norio Miyake (Kansai Electric Power Co., Inc., Japan). Elec. Power (Kyoto), 47: No. 10, 32-5; 40(Sept. 1963). (In Japanese)

Results of experiments carried out by Kansai Electric Power Company at the upper reaches of Kurobe River to evaluate the snow fall with a gage using gamma radiation are described. The snow gage was placed on the Kariyasu Pass 1,960 m above sea level, south of Tateyama Mountain Range. The electrical pulses from the detectors were transmitted by radio to the receiving station at Kurobe IV Power Station about 4.5 km down stream, where the data were interpreted and tabulated. The radiation source, 350 mC of cobalt-60, was located 4 m above ground. This strength of radioactivity was used because the activity from this source penetrating the water equivalent of 3 m (the maximum thought) was higher than the background radiation. Two halogen counters were used as the detectors, one 3.99 m above the source and the other 4.05 m below. Measurements were made from Nov. 1, 1962 to May 15, 1963. After the water equivalent was at a maximum at the end of March, it decreased as snow melted and became zero on May 15. These results from the telemeter agreed well with those obtained by the photographic method (February 14 and March 26). The maximum water equivalent of the snow fall in the catchment area of the Kurobe IV Dam was estimated to be 240,000,000 tons. (NSA of Japan)

31849 PROGRESS IN THE DEVELOPMENT OF GAGES USING RADIATION. Tetsuo Sumi (Hitachi, Ltd., Japan). Genshiryoku Kogyo, 9: No. 11, 6-9(Nov. 1963). (In Japanese)

Gages using radiation and uses in industry in Japan are described. These gages measure various quantities by the interaction of radiations (γ, β, α rays and neutrons) with matter. Water-level gages and thickness gages are most common at the present. Radioisotopes emitting suitable radiation with a long half-life, which are cheap and easy to handle, should be chosen as the radiation sources. As these gages have been greatly improved in recent years, they are often used in the control system in industry. Many examples of recent applications are given. To use the gages effectively, it is important to have an exact knowledge of their performances and to find the arrangement best fitted to their purpose. In the actual installation of the gages, ordinary industrial practices are also necessary. The maintenance for these gages and the personal protection against radiation are also described. (NSA of Japan)

31850 RADIATION EFFECTS ON ELECTRONIC COMPONENTS AND ELECTRONIC EQUIPMENTS. II. RADIATION EFFECTS ON TEMPERATURE CHARACTERISTICS OF ELECTRONIC COMPONENTS. Hideo Yamaoki and Hiroshi Ikushima (Matsushita Electric Industry Co., Ltd., Japan). Natl. Tech. Rept. (Matsushita Elec. Ind. Co.). Osaka, 10: No. 1, 13-31(Feb. 1964). (In Japanese)

Test samples were exposed to γ rays from ^{60}Co sources of 5,000, 2,000, and 100 curies, and to integrated pile dosages of $0.4-1.0 \times 10^{16}$ nvt. The gamma-irradiation effect on electrical properties of electronic component parts was generally appreciable, but the effect on temperature characteristics was not eminent except in some cases. Most of these effects were temporary, disappearing after removal from the radiation field. Pile-irradiation effects on electronic components were measured only after exposure. The passive elements bombarded in a reactor showed little change in electrical properties including temperature dependence, while diodes and transistors exhibited considerable degradation in characteristics. In addition, it was noted that surface effects were responsible for the property change of diodes and transistors in a γ-ray field.

Microminiaturized parts of passive elements were as sensitive to nuclear radiation as those of ordinary size. (auth)

31851 CURRENT HARMONICS IN ELECTRON BEAMS IN TRAVELING WAVE TUBES. Yu. N. Badlevskii. Radiotekhn. i Elektron., 9: 830-7(May 1964). (In Russian)

Amplitudes of current harmonics were studied as a function of tube parameters at small Pearce C magnitudes. (tr-auth)

31852 CALIBRATION SYSTEM WITH MICROINCH PRECISION AT TEMPERATURES TO 500°C. J. C. Spanner and B. B. Brenden (General Electric Co., Richland, Wash.). Rev. Sci. Instr., 35: 944-9(Aug. 1964).

A reference system for the evaluation and calibration of microdisplacement readout systems is described. The basic reference system consists of several pieces of precision readout and positioning equipment, a high temperature test chamber, and a specially designed linkage system. The case temperature of the transducer under calibration is maintained constant to within ±0.5°C for temperatures to 500°C. A quartz and Invar linkage system provides a minimum expansion method of coupling linear motion, through a heat shield, from the readout equipment to the transducer located in a test chamber. The reference system is periodically calibrated, and a basic reference system precision of ±0.3% or better for operational ranges from 0.004 to 0.500 in. was established. (auth)

31853 PERFORMANCE STUDIES OF A QUADRUPOLE MASS FILTER. Wilson M. Brubaker and Johannes Tuul (Bell and Howell Research Center, Pasadena, Calif.). Rev. Sci. Instr., 35: 1007-10(Aug. 1964).

The transmission efficiency and the resolving power of a quadrupole mass filter were investigated as functions of entrance aperture size and frequency of excitation. The aperture size was varied from 10 to 40% of the rod diameter, and the frequency of excitation ranged from 0.87 to 1.7 Mc. Larger transmitted ion currents at lower transmission efficiencies were observed with the larger aperture sizes. Higher resolution was obtained more readily with smaller apertures and higher frequencies. (auth)

31854 ULTRAVIOLET LAMP FOR THE GENERATION OF INTENSE, CONSTANT-SHAPE PULSES IN THE SUB-NANOSECOND REGION. Juan T. D'Alessio, Peter K. Ludwig, and Milton Burton (Univ. of Notre Dame, Ind.). Rev. Sci. Instr., 35: 1015-17(Aug. 1964).

A commonly available mercury contact relay was modified to make a uv lamp which yields a spark with approximately 100 times the intensity of the original relay and with a constant characteristic risetime of 0.4 nsec, a decay time of 0.55 nsec, and a half-width of 0.5 nsec. The lamp can be used not only for fluorescence decay-time studies, but also for electrical applications in the subnanosecond region. It was operated in the range from 3 to 50,000 pulses per second. (auth)

31855 CRYOSTAT DESIGN PERMITTING LOCALIZED TEMPERATURE CONTROL FROM 20 TO 870°K. J. C. Robinson (Atomics International, Canoga Park, Calif.). Rev. Sci. Instr., 35: 1017-20(Aug. 1964).

A cryostat for heat treating small specimens over wide temperature ranges is described. With this device it is possible to rapidly raise, lower, or hold the temperature of a small specimen without the use of a mechanical type of heat switch arrangement. A low inertia, high temperature heater is also discussed. (auth)

31856 WIDEBAND HIGH VOLTAGE PROBE. R. Keller (Laboratoire de Recherches sur la Physique des Plasmas, Fonds National Suisse de la Recherche Scientifique, Lausanne, Switzerland). Rev. Sci. Instr., 35: 1057-60 (Aug. 1964).

A high-voltage probe based on the principle of consecutive differentiation and integration is described. The voltage to be measured is applied to a coupling capacitor of a few $\mu\mu$F and rated at several tens of kilovolts. The capacitor is connected to a cable which propagates a signal proportional to the derivative of the voltage. At the other end of the cable, a transistorized integrator integrates the current and produces a signal proportional to the voltage. A bandwidth of 300 c to 200 Mc can be obtained. (auth)

31857 METHOD OF IMAGING CESIUM ION BEAMS. Thomas C. Sanders (Lockheed Missiles and Space Co., Palo Alto, Calif.). Rev. Sci. Instr., 35: 1082-3(Aug. 1964).

Images of ion beams from a multiple-strip-beam ion engine were obtained by placing a piece of aluminum foil normal to the beam at the desired location. The image darkness varied with the beam current, and the contrasts between the areas of the image and between the image and the background were sharp. The images were not affected by exposure to air or water, but could be removed by scraping. (D.C.W.)

31858 SOLID-STATE ELECTRIC FIELD GENERATOR FOR THE MONOPOLE GAS ANALYZER. S. J. Lins and M. C. Paul (UNIVAC, St. Paul). Rev. Sci. Instr., 35: 1084-5(Aug. 1964).

A solid-state circuit for producing the monopole electric field of a monopole mass filter is described. (D.C.W.)

31859 ELECTRON BOMBARDMENT ION SOURCE FOR A MASS SPECTROMETER. Saburo Magari and Kokichi Hotta (Kyoto Univ.). Shitsuryo Bunseki, 11: No. 23, 94-9(Oct. 1963).

The influence of an auxiliary magnetic field in the region of the ion source, of spreading of the electron beam, and of geometrical position of electron path in the ionization chamber upon ion currents was studied. The study led to the following conclusions. A source magnet minimizes the spreading of the electron beam but does not improve the gain essentially. Ion currents may be increased if the source magnet deflects the electron beam to the first ion slit. A source magnet is unnecessary when the electron beam is focused by a filament shield. It is found that more stable operating conditions can be obtained without an auxiliary magnetic field in the region of the ion source when the electron beam passes through as near the first ion-accelerating slit as possible and the rate of ion production is not proportional to the cross section of the electron beam. (auth)

31860 ELECTROMAGNETIC SLOW WAVE SYSTEMS. R. M. Bevensee. New York, John Wiley & Sons, Inc., 1964. 477p.

Electromagnetic slow-wave systems are analyzed from the point of view of mode coupling techniques and general variational methods. The analyses yield both theorems and specific performance characteristics for microwave beam amplifiers, linear accelerator structures, and parametric amplifiers. General properties of slow wave structures, analyses of helices and loaded waveguides, radiation and cavity coupling, variational analyses for general helical slow wave structures, resonant-slot and resonant-loop coupled cavity chains, electron beam interactions with slow wave structures, cavity-chain beam tubes operated in narrow passband, design considerations for klystron beam amplifiers, and parametric and maser slow wave systems are presented. (R.E.U.)

31861 RESEARCH STATUS AND NEW DEVELOPMENTS OF PHOTOMULTIPLIER TUBES AT L.E.P. G. Pietri. 26p. (CONF-182-29). (In French)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

A brief review is given of the work done on photomultiplier tubes at L.E.P. The studies were concentrated on a systematic analysis of the signal and the background. Applied investigations on the improvement of the response rapidity and the length of the pass band are reported. Recent industrial improvements are cited. (J.S.R.)

31862 IMPROVEMENTS IN OR RELATING TO INSTRUMENTS FOR GAUGING MATERIAL PROPERTIES BY NUCLEAR RADIATION TECHNIQUES AND TO RADIATION SOURCES. Arthur Abbey (to Industrial Nucleonics Corp.). British Patent 962,990. July 8, 1964. Filed Dec. 13, 1960.

The capacity of the nuclear powered x-ray generator for providing radiation sources for improved measurement performance in thickness gauging is extended by combining the desirable features of a beta source and a stable medium-energy x-ray source. An instrument comprising apparatus for producing a modified radiation beam, a radiation detector, and means for registering the output of the detector is designed. (L.B.S.)

31863 CONTROLLED GAS-FILLED NEUTRON TUBE. E. P. Gel'. Russian Patent 159,240.

A controlled gas-filled neutron tube is described, which works on a deuterium-tritium reaction and contains an ion source with an axial magnetic field, cylindrical anode, and two cathodes on its ends, one of which is an efficient source of ionizing thermoelectrons. For controlling the ion current density, a fine-mesh grid is placed between the ion source and the high voltage electrode. The positive potential on this grid regulates the flow of ions to the target. (OTS)

Radiation Detection

Refer also to abstracts 31314, 31340, and 31576.

31864 (AD-429439) SPECTRAL RESPONSE STUDY AND CALIBRATION OF AERIAL SURVEY METER CD V-781BX. Final Report. Frederick Jennings (Eon Corp., Brooklyn). Dec. 1963. Contract OCD-OS-63-51. 47p.

Results of a spectral response study and calibration of the aerial survey meter over the energy range 80 kev to 1.2 Mev are presented. The meter utilizes three separate detectors to provide three ranges (0.1, 1, and 10 r/hr). Each of these detectors was successfully corrected for spectral response to within the required plus or minus 10%. Drawings and specifications for each detector shield were developed. It seems feasible to have these detectors supplied with "built-in" spectral correction for ASM application. Unexpected difficulty was encountered in this task because many of the detectors proved to be unstable in operation as a function of time. This is a serious situation and may result in dangerous inaccuracy of measured results. It is recommended that the tube specifications be revised to include active and shelf-life requirements; that stability sampling tests be performed on all detectors prior to initial installation in aerial survey meters; that the test circuitry be made to reflect the actual mode of operation in the equipment; and that the stringent shock and vibration requirements (which now appear in the equipment specification) be made a part of the detector specifications to prevent acceptance of mechanically fragile detectors. (auth)

31865 (AE-144) A DIRECTION-SENSITIVE FAST NEUTRON MONITOR. B. Antolkovic, B. Holmqvist, and T. Wiedling (Aktiebolaget Atomenergi, Stockholm). June 1964. 14p.

A direction-sensitive fast-neutron monitor is described and its properties are discussed. The counter is a modification of the standard long counter of the Hanson and McKibben type. Directional sensitivity is obtained by increasing the shielding of the counter and providing it with a 70-cm long collimator channel. The behavior of this long counter monitor is compared with that of a standard long counter when both are used in neutron experiments. (auth)

31866 (AWRE-O-26/64) THE INTERCOMPARISON OF $4\pi\ \beta$ PROPORTIONAL COUNTING TECHNIQUES IN CANADA, UK AND USA. PART 2. S-35 AND Ni-63. R. L. G. Keith, D. E. Watt, and F. Brown (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). May 1964. 9p.

Solutions of ^{63}Ni and ^{35}S were prepared at AWRE and were sent to the participating laboratories, together with infrared-dried $4\ \pi$ sources on VYNS. All the sources were counted at AWRE to permit determination of the relative counter efficiencies of the laboratories. Results were also obtained with sources prepared at the laboratories. The results show that direct proportional counting of heat- or air-dried sources should not be used. Freeze-drying and extrapolation of derived specific activity against source weight seems to be most reliable. (D.C.W.)

31867 (BM-RI-6465) HIGH-LEVEL GAMMA-RAY DOSIMETRY AT THE ALBANY COBALT 60 FACILITY. Stephen D. Hill and F. E. Block (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Oct. 1963. 18p.

Techniques by which the exposure radiation dose from high-level ^{60}Co can be determined were investigated. Methods including ferrous sulfate, ceric sulfate, and methyl methacrylate chemical dosimeters, ion chamber dosimetry, and an absolute radiation calorimeter were investigated. Isodose curves were constructed for several standard source configurations using the dosimetry techniques which were investigated. It is pointed out that applications of radiation dosimetry to measure larger radiation doses in fields such as materials engineering and process radiation chemistry have resulted in a need for dosimeters that can measure large dose rates quickly, accurately, and inexpensively. (C.H.)

31868 (BNL-850) HIGH RESOLUTION AT LOW ENERGIES WITH AN IRON DOUBLE-FOCUSING BETA-RAY SPECTROMETER. I. Bergstrom, Y. Y. Chu, and G. T. Emery (Brookhaven National Lab., Upton, N. Y.). Mar. 1964. Contract [AT(30-2)-Gen-16]. 4p.

Line resolution in a double-focusing beta spectrometer was studied after adding shims of soft iron around the outside of the spectrometer. The 44-kev transition in the decay of ^{79}Kr, with a K-conversion line at 31 kev and KLL Auger electrons at 10 kev, was used to investigate the instrumental line shape. (R.E.U.)

31869 (CERN-64-30) PROCEEDINGS OF THE INFORMAL MEETING ON FILMLESS SPARK CHAMBER TECHNIQUES AND ASSOCIATED COMPUTER USE, GENEVA, MARCH 1964. G. R. Macleod and B. Maglic, eds. (European Organization for Nuclear Research, Geneva). 405p.

Separate abstracts were prepared for 41 of the 44 complete papers presented; 3 were previously included in NSA (17: 20347; 18: 29971, 30338). (R.E.U.)

For abstracts of individual papers see: 31870, 31871, 31872, 31873, 31874, 31875, 31876, 31877, 31878, 31879, 31880, 31881, 31882, 31883, 31884, 31885, 31886, 31887, 31888, 31889, 31890, 31891, 31892, 31893, 31894, 31895, 31896, 31897, 31898, 31899, 31900, 31901, 31902, 31903, 31904, 31905, 32015, 32265, 32266, 32308, and 32309.

31870 (CERN-64-30(p.3-9)) ON-LINE COMPUTERS IN DATA ANALYSIS SYSTEMS FOR HIGH-ENERGY PHYSICS EXPERIMENTS. G. R. Macleod (European Organization for Nuclear Research, Geneva).

Previous work in spark chambers and on-line computers is reviewed as an introduction to the conference at Geneva. (R.E.U.)

31871 (CERN-64-30(p.11-20)) A COUNTER HODOSCOPE DIGITAL DATA AND ON-LINE COMPUTER SYSTEM USED IN HIGH-ENERGY SCATTERING EXPERIMENTS. K. J. Foley, S. J. Lindenbaum, W. A. Love, S. Ozaki, J. J. Russell, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). (BNL-7919)

A counter hodoscope system used at the Brookhaven 33-Bev AGS to investigate the differential cross sections for elastic scattering of high-energy protons, antiprotons, K mesons and π mesons from protons is described. The system features automatic data handling and on-line computer (Merlin) analysis with immediate feedback of results to experimenters. (R.E.U.)

31872 (CERN-64-30(p.41-8)) SONIC SPARK CHAMBER SYSTEM WITH ON-LINE COMPUTER FOR PRECISION MEASUREMENT OF MUON DECAY SPECTRUM. M. Bardon, J. Lee, P. Norton, J. Peoples, and A. M. Sachs (Columbia Univ., New York).

The use of an IBM 1401 computer with four single-gap thin spark chambers inside a 1-meter diameter magnet for precision determination of the momentum spectrum of positrons in the decay of meson (μ) is discussed. The digitized information is placed directly on magnetic tape Beam stopping and triggering components are described. The IBM 1401 was used to transfer the digitized time intervals to magnetic tape for later analysis of events on an IBM 7094. Reliability is discussed. (R.E.U.)

31873 (CERN-64-30(p.49-56)) SYSTEM CONSISTING OF SONIC SPARK CHAMBERS, TIME-OF-FLIGHT AND PULSE-HEIGHT COUNTERS ("MISSING-MASS SPECTROMETER") WITH ON-LINE COMPUTER. H. Blieden, D. Freytag, F. Iselin, F. Lefebvres, B. Maglic, H. Slettenhaar, S. Almeida, and A. Lang (European Organization for Nuclear Research, Geneva).

The "missing-mass spectrometer" built at CERN is described. The data handling system, including a Ferranti Mercury computer, is described for investigations of reactions $\pi^- + p \rightarrow p + x^-$ where x is an unstable boson. (R.E.U.)

31874 (CERN-64-30(p.57-63)) SPARK CHAMBER VIDICON SCANNER WITH DISCRETE SCAN. W. Vernon (Princeton Univ., N. J. Palmer Physical Lab.).

A scanning system is described in which the vidicon's scan format has the same number of scan lines as spark chamber gaps. The scanning beam is stopped at sparks to allow the recording of their position so that the vidicon's storage properties are fully exploited. The operation of the scanner is discussed. (R.E.U.)

31875 (CERN-64-30(p.65-79)) AUTOMATIC DIGITIZATION OF SPARK CHAMBER EVENTS BY VIDICON SCANNER. S. W. Andreae, F. Kirsten, T. A. Nunamaker, and V. Perez-Mendez (California. Univ., Berkeley. Lawrence Radiation Lab.). (UCRL-11209; CONF-416-4)

The digitizing system described consists of a vidicon tube with associated electronic circuits built into a shielded assembly that can operate in an environment of spark chamber and accelerator electrical noises. The system is designed to store the locations of two sparks per gap per view of the chamber. The digitization is accomplished by 20-Mc scalers that record the positions of the sparks relative to a system of fiducial slits located at the extremities of each chamber view. The digitized information is temporarily stored in a 6000-bit magnetic core buffer and then transferred onto magnetic tape for subsequent processing by an IBM 7090 computer. The digitizing logic and digitized data compiler are discussed. (R.E.U.)

31876 (CERN-64-30(p.81-93)) VIDICON SYSTEM AT CHICAGO. H. L. Anderson, S. Fukui, R. Gabriel, et al. (Chicago. Univ.).

A vidicon system, used with eithg spark chambers, is described that is based on commercial closed-circuit TV units connected to an analog-to-digital converter and circuitry to read the spark positions directly onto magnetic tape. (R.E.U.)

31877 (CERN-64-30(p.95-104)) A VIDICON SPARK CHAMBER SYSTEM FOR USE IN ARTIFICIAL EARTH SATELLITES. G. G. Fazio (Smithsonian Astrophysical Observatory, Cambridge and Harvard Univ., Cambridge, Mass. Harvard Coll. Observatory).

A vidicon spark chamber system for measuring high-energy gamma rays in satellites is proposed. The system is described and satellite-to-earth data transmission is considered, briefly. (R.E.U.)

31878 (CERN-64-30(p.105-9)) VIDICON DEVELOPMENT FOR THE LUND SYNCHROTRON. G. von Dardel (European Organization for Nuclear Research, Geneva) and G. Jarlskog (Lund, Sweden. Univ. Inst. of Physics).

The development of a vidicon spark chamber system for use with the 1.3-Bev Lund electron synchrotron in measurements of the polarization of recoil protons in meson (π) photoproduction by polarized gamma rays is discussed. (R.E.U.)

31879 (CERN-64-30(p.111-16)) A SIMPLE DIGITIZED CHAMBER. I. Pizer (European Organization for Nuclear Research, Geneva).

A wire spark chamber was developed using printed-circuit techniques and grouping of wires for single sparks. Operation of the chamber is discussed. (R.E.U.)

31880 (CERN-64-30(p.117-22)) MAGNETIC SPECTROMETER SYSTEMS USING DIGITIZED DISCHARGE PLANES. G. B. Collins, J. Fischer, and W. A. Higinbotham (Brookhaven National Lab., Upton, N. Y.).

Some properties and applications of digitized discharge planes being developed at Brookhaven are discussed. (R.E.U.)

31881 (CERN-64-30(p.123-8)) WIRE CHAMBERS FOR INELASTIC e-p SCATTERING. D. Miller and P. de Bruyne (Harvard Univ., Cambridge, Mass.).

Some requirements of wire spark chambers are considered, and the development of a chamber for inelastic e-p scattering experiments are discussed. (R.E.U.)

31882 (CERN-64-30(p.129-31)) AN INTEGRATED WIRE CHAMBER COMPUTER SYSTEM. J. Bounin, R. H. Miller, M. J. Neumann, and H. Sherrard (Chicago. Univ. Inst. for Computer Research).

A wire and core spark chamber for use on-line with a computer is discussed, in summary only. (R.E.U.)

31883 (CERN-64-30(p.133-9)) SECONDARY DISCHARGE SPARK CHAMBER OPERATION. M. J. Neumann (Chicago. Univ. Inst. for Computer Research).

The possible uses of spark chambers are discussed for the period of secondary discharge. (R.E.U.)

31884 (CERN-64-30(p.141-5)) DATA HANDLING IN Mu MESON PAIR PRODUCTION AT CEA. M. Gettner, J. Larabee, R. Weinstein (Northeastern Univ., Boston); A. Boyarski, J. Fridman, G. Glass, H. Kendall (Massachusetts Inst. of Tech., and J. de Pagter (Cambridge Electron Accelerator, Mass.).

The coincidence system used to detect and register meson (μ) pairs is discussed. (R.E.U.)

31885 (CERN-64-30(p.147-55)) AN EXPERIMENT ON THE ELASTIC SCATTERING OF DEUTERONS ON CARBON. L. Bird, B. Rose, C. Whitehead, E. Wood (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England); E. G. Auld, D. G. Crabb, G. W. Hutchinson, and J. G. McEwen (Southampton, England, Univ.).

Operation of sonic spark chambers was investigated in elastic scattering of deuterons by carbon at 70 Mev. Computer analysis of the results is presented. (R.E.U.)

31886 (CERN-64-30(p.157-69)) OPERATION OF A SONIC SPARK CHAMBER SYSTEM. A. Lillethun, B. Maglic, C. A. Stahlbrandt, A. Wetherell (European Organization for Nuclear Research, Geneva); G. Manning, A. E. Taylor, and T. G. Walker (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England).

Sonic spark chambers were used to study small-angle p-p elastic scattering using 26-Bev/c beams from the CERN PS. (R.E.U.)

31887 (CERN-64-30(p.171-82)) DESCRIPTION OF THE MATHEMATICS INVOLVED IN THE RECONSTRUCTION OF SPARK POSITIONS IN AN ACOUSTICAL SPARK CHAMBER. E. Lillethun and P. Zanella (European Organization for Nuclear Research, Geneva).

Mathematical methods for locating spark positions in sonic chambers are discussed. (R.E.U.)

31888 (CERN-64-30(p.183-90)) ACOUSTICAL SPARK CHAMBER SYSTEM FOR THE STUDY OF SMALL-ANGLE PROTON-PROTON SCATTERING. G. Cocconi, A. N. Diddens, E. Lillethun, J. Pahl, A. C. Sherwood, J. P. Scanlon, C. A. Strahlbrandt, C. C. Ting, J. Walters, and A. N. Wetherell (European Organization for Nuclear Research, Geneva).

The system and some preliminary results are described. (R.E.U.)

31889 (CERN-64-30(p.191-202)) A SONIC SPARK CHAMBER SYSTEM USING LONG MICROPHONES. B. D. Jones, J. Malos (Bristol Univ., England); W. Galbraith, and G. Manning (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England).

Tests were carried out with long microphones in chambers designed for use in experiments on elastic charge-exchange scattering of neutrons by protons. The experimental arrangement and procedures for data analysis are described. (R.E.U.)

31890 (CERN-64-30(p.211-19)) MEASURING, RECORDING AND INTERFACE FOR SONIC SPARK CHAMBERS. F. Iselin, A. Lang, A. Maurer, Ph. Ponting, and E. Schuller (European Organization for Nuclear Research, Geneva).

Requirements for electronic equipment used in data handling for sonic spark chambers are discussed. (R.E.U.)

31891 (CERN-64-30(p.221-7)) A PAIR SPECTROMETER USING ACOUSTIC SPARK CHAMBERS AND OTHER EXPERIMENTS IN PREPARATION. P. T. Andrews, P. G. Butler, N. Cohen, A. N. James, B. G. Lowe, and J. P. Nicholson (Liverpool. Univ.).

The microphones and electronics for use in spark chamber studies of photon energies from $\pi^- + D \rightarrow N + N + \gamma$ and in quasielastic scattering of 400-Mev protons by nuclei are described. (R.E.U.)

31892 (CERN-64-30(p.229-36)) ACOUSTIC SPARK CHAMBER SYSTEM FOR BEAM MOMENTUM MEASUREMENT. R. J. Ellison, R. Marshall, A. J. Wynroe, B. Dickinson (Manchester, England. Univ.); and D. M. Binnie (Imperial Coll. of Science and Tech., London).

A sonic spark chamber system for momentum measurements of a particle beam is described that is intended for use in studies of rare decay modes of ω^0. The system produces parallel outputs, one of which is the momentum. The analog circuit features high accuracy. The 3-gap chamber is of the circular foil type with modular system construction. (R.E.U.)

31893 (CERN-64-30(p.251-60)) A SONIC SPARK CHAMBER SYSTEM WITH ON-LINE COMPUTATION FOR STUDYING THE REACTION $\pi^- + p \rightarrow f^0 + n$ AT 3 Gev/c. L. Bird (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England); D. G. Crabb (Southampton, England. Univ.); D. Aitken (London. Univ. University Coll.); E. G. Auld, et al. (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England).

A data handling system for use with sonic spark chambers is being developed using a ferrite core store with a capacity of 128 16-bit words and with capabilities for on-line connection of a Ferranti ORION computer. The system is for use in NIMROD experiments of the type $\pi^- + p \rightarrow n + f^0$ where the neutron angular distribution is studied. The chambers are of the two-gap foil type. (R.E.U.)

31894 (CERN-64-30(p.261-3)) ON-LINE TRACK IDENTIFICATION FOR WIRE CHAMBERS. D. Miller and C. Freed (Harvard Univ., Cambridge, Mass.).

The use of a PDP computer on-line with wire spark chambers is discussed. Track identification is accomplished by buffer registry and subsequent transfer to magnetic tape, which isolates the tape transport from the randomness of event rates and retains wire locations in the computer memory long enough for track identification and display. (R.E.U.)

31895 (CERN-64-30(p.265-78)) LINK AND PAIR (CDC-3600 PROGRAMMES FOR THE ASSOCIATION OF SPARK IMAGES INTO TRACKS). R. F. Clark (Argonne National Lab., Ill.).

The PAIR (3-dimensional reconstruction) and LINK (linking into tracks) programs in the AIRWICK system for spark chamber data processing using CDC-3600 are described. Data from photographs, vidicon systems, and sonic or wire chambers is processed for a set input into geometry and kinematics programs. (R.E.U.)

31896 (CERN-64-30(p.287-98)) SOME REFLECTIONS ON SYSTEMS FOR THE AUTOMATIC PROCESSING OF COMPLEX SPARK CHAMBER EVENTS. A. Roberts (Argonne National Lab., Ill.).

Systems for automatic recording and analysis of digitized data from events of arbitrary complexity are discussed. The advantages of wire array systems are discussed. (R.E.U.)

31897 (CERN-64-30(p.325-31)) A MAGNETOSTRICTION METHOD FOR SPARK LOCALIZATION. G. Giannelli (Bari, Italy. Universita. Istituto di Fisica).

Spark localization in chambers with wire and plate electrodes was studied. The wire electrode was Fe–50 wt % Co alloy. The elastic deformation waves propagating along the wire were studied. (R.E.U.)

31898 (CERN-64-30(p.333-40)) DETERMINATION OF THE POSITION OF SPARKS BY MEANS OF MEASUREMENT OF CURRENTS. G. Charpak, J. Favier, and L. Massonnet (European Organization for Nuclear Research, Geneva).

The measurement of the relative distribution of currents when several channels are offered to the current for leaving the electrode after the discharge is proposed to determine spark position. (R.E.U.)

31899 (CERN-64-30(p.341-4)) ELECTROSTATIC PHOTOGRAPHY AS A MEANS TO OBTAIN MAGNETIC RECORDS OF SPARK CHAMBER PICTURES. G. Charpak, P. Duteil, R. Meunier, M. Spighel, and J. P. Stroot (European Organization for Nuclear Research, Geneva).

The use of electrophotography to provide fast access to spark chamber information is discussed. (R.E.U.)

31900 (CERN-64-30(p.345-9)) DIRECT RECORDING ON MAGNETIC TAPE IN SPARK CHAMBERS. E. Quercigh (Milan. Universita. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Milan).

The use of magnetic tape for direct recording of spark chamber events was investigated. A single-gap chamber was used to test the proposal. (R.E.U.)

31901 (CERN-64-30(p.351-6)) A SPARK CHAMBER OF THREE-DIMENSIONAL RESOLUTION. E. Gygi and F. Scheider (European Organization for Nuclear Research, Geneva).

Electron multiplication mechanisms were studied for application to delineation of a particle track by a pulsed discharge. Photographic devices and techniques used to record the event are described. (R.E.U.)

31902 (CERN-64-30(p.361-3)) COMPARATIVE STUDY OF SPARK CHAMBER DATA RECORDING SYSTEMS. I. PROPERTIES OF VIDICON DATA ACQUISITION SYSTEMS. V. Perez-Mendez (California. Univ., Berkeley. Lawrence Radiation Lab.).

Spatial resolution, time resolution, capacity, construction, costs, and uses are discussed for vidicon systems. (R.E.U.)

31903 (CERN-64-30(p.363-5)) COMPARATIVE STUDY OF SPARK CHAMBER DATA RECORDING SYSTEMS. II. SONIC LOCATION OF SPARKS. A. E. Taylor (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England).

Spatial resolution, time resolution, data storage gap numbers, construction, costs, and present status of sonic spark chambers are discussed. (R.E.U.)

31904 (CERN-64-30(p.365-7)) COMPARATIVE STUDY OF SPARK CHAMBER DATA RECORDING SYSTEMS. III. COMPARISON CHART FOR DIGITIZED DISCHARGE PLANES (WIRE ARRAY). D. Miller (Harvard Univ., Cambridge, Mass.).

Properties of wire arrays for spark chambers are discussed. (R.E.U.)

31905 (CERN-64-30(p.367-9)) COMPARATIVE STUDY OF SPARK CHAMBER DATA RECORDING SYSTEMS. IV. PROPERTIES OF CONVENTIONAL CAMERA-FILM DATA ACQUISITION SYSTEMS WITH NARROW GAP SPARK CHAMBERS. A. Roberts (Argonne National Lab., Ill.).

Space and time resolution, construction, costs, and uses of photographic film systems are discussed. (R.E.U.)

31906 (HW-81871) FAST-NEUTRON DOSIMETRY: INTERCALIBRATION OF COUNTING FACILITIES. H. H. Yoshikawa and W. H. Zimmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT(45-1)-1350. 24p.

The coordinated program for standardization of neutron flux and exposure determinations among ANL, BMI, BNL, GA, GE-HAPO, GE-NMPO, GE-VAL, ORNL, and Phillips is discussed. Techniques and results are discussed. (R.E.U.)

31907 (ISS-64/11) IMPIEGO DI RIVELATORI A SEMICONDUTTORE PER COINCIDENZE RAPIDE. (Fast Coincidences with Semiconductor Detectors). L. Maiani (Italy. Istituto Superiore di Sanita, Rome). Apr. 4, 1964. 32p.

A circuit for fast γ-γ coincidences is described, in which semiconductor detectors (lithium-ion drift) are employed. The resolving power obtained for 1-Mev γ-rays is about 7 nsec (FWHM): this resolution is compared with the one calculated from the height and form of the pulses at the outputs of the amplifiers. (auth)

31908 (LADC-5823) POWER CALIBRATION ERRORS FROM ELECTRICALLY COMPENSATED ION CHAMBERS. J. Harry Mortenson (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 10p.

The errors associated with the use of electrically gamma-compensated ionization chambers under conditions that give rise to large gamma-to-neutron ratios were investigated in power calibrations for Kiwi B-1B and B-4A tests involving the use of a water tank for neutron flux attenuation. (R.E.U.)

31909 (LNF-64/18) A NEW BILATERAL FAST LINEAR GATE CIRCUIT. Note No. 242. M. Coli and S. Lupini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). May 20, 1964. 7p.

A linear gate for 1 nsec minimum width pulse is described. The minimum gate duration is 5 nsec, and the rejection ratio for nongated pulses is 30 db at maximum amplitude of 120 mamp output pulse. Attenuation of allowed pulses is 0.7 db. A gating pulse generator is also described that is capable of repetition rates up to 100 Mc. (auth)

31910 (NBS-5471) REMOTE RADIATION-MONITORING SYSTEM. L. Costrell (National Bureau of Standards. Radiation Physics Lab., Washington, D. C.). Sept. 30, 1957. 51p.

The design and operation of a remote radiation-monitoring system developed for use at the Nevada Test Site are discussed. Modifications to initial designs are shown. The report supersedes NBS-4148 and NBS-5124. (R.E.U.)

31911 (NP-13998) ZUR ABSOLUTZAHLUNG VON β-STRAHLERN MIT FLUSSIGEN SZINTILLATOREN UND MIT DER β-γ-KOINZIDENZMETHODE (THESE). (On the Absolute Counting of β Radiation with Liquid Scintillators and with a β-γ-Coincidence Method (thesis)). Gerhard

Erdtmann (Johannes-Gutenberg-Universität, Mainz). 1963. 231p.

The most important methods for absolute counting are summarized. Some that could be used for the measurement of short-lived isotopes under certain limiting conditions are indicated. The work is divided into two sections: pure β counting and β-γ coincidence counting. The 4-π counter is briefly reviewed using some studies appearing in the past five years. The study of liquid scintillators is introduced with a literature search. The measurement methods and error sources in work with liquid scintillators are described and discussed. The preparation of homogeneous samples, together with the determination, significance, and elimination of errors in the preparation is considered in some detail. The counting yield in liquid scintillation counting is somewhat under 100%, but is scarcely disturbed in β-γ coincidence measurements. The coincidence method is considered on the assumption that β detectors of high detection probability are used. The theory is discussed, and the sources of error reported. Some new theoretical considerations were necessary for the liquid scintillator coincidence measurements. It is shown that the geometric error is very small. The γ sensitivity of the β detector produces an error that can be estimated by a scheme described or eliminated by a graphic method. The dead time corrector and coincidence time corrector are described in the literature. The correction error was calculated for the instruments used. The statistical error of a coincidence measurement is also treated. The coincidence apparatus used is described, and its contribution to the experimental results was critically evaluated. Coincidence measurements with ^{60}Co, ^{22}Na, ^{124}Sb, ^{198}Au, and Zr-^{95}Nb were made. The results of various measurement and evaluation methods were compared with each other and with the results of pure β measurements. (tr-auth)

31912 (NP-14089) K IZMERENIYAM ENERGETICHESKIKH SPEKTROV BYSTRYKH NEITRONOV V REAKTORAKH S POMOSHCH'YU POROGOVYKH INDIKATOROV. (Measurements of the Energy Spectra of Fast Neutrons in Reactors by Means of Threshold Indicators). I. S. Panasyukh (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 14p.

A method for measuring the spectra of absolute neutron flux in a designated place in a reactor was developed using previously calculated spectra for relative neutron fluxes and absolute specific activity of threshold detectors. The method, in addition to selecting and transforming into absolute spectra, is capable of indicating errors made in estimating the absolute specific activity of the detectors. (tr-auth)

31913 (NP-14121) USE OF THE FRICKE DOSIMETER FOR THE MEASUREMENT OF DOSES BELOW 1000 RADS. S. M. Pribićević, O. S. Gal, and I. G. Draganić (Institut za Nuklearne Nauke "Boris Kidric," Belgrade). [1967]. 27p.

Doses below 1000 rads were measured with the Fricke dosimeter. The concentration of ferric iron was determined by the following four methods: 1. The method of direct spectrophotometric measurement of ferric ions using 4 cm cells. Above 300 rads, the relative error of the method is ±2%; from 300 to 100 rads this error successively rises to about 10%. 2. The thiocyanate spectrophotometric method; (a) with 1 cm cells for doses above 200 rads. The relative error is ±2%; (b) with 4 cm cells for doses below 200 rads. In the range from 200–100 rads the relative error is ±2%, and from 100–30 rads it is ±3%. 3. The radioactive tracer method—extraction of the thiocyanate complex with isoamylalcohol. This method gives a relative error of ±5%. 4. The radioactive tracer method—isolation of ferric iron by zirconium phosphate ion exchanger. The relative error of the method is about ±5% for doses higher than 40 rads. In both spectrophotometric methods one must take into account the oxidation of the reference solution, whereas the tracer method requires a blank run. For a smaller number of measurements above 300 rads, the most suitable is the direct spectrophotometric method (4 cm cells). The thiocyanate spectrophotometric method (1 cm cells) is preferred in the range from about 150 to 300 rads. For routine measurements, however, the method of ion-exchange columns has many advantages. The thiocyanate spectrophotometric (4 cm cells) and the ion-exchange method are equally well suitable for doses below 150 rads to about 30 rads. The four analytical methods are in good agreement, and the measurements are reproducible. (auth)

31914 (SC-R-64-197) USE OF FERROELECTRICS FOR GAMMA-RAY DOSIMETRY. D. L. Hester, D. D. Glower, and L. J. Overton (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 10p. (CONF-617-9)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

A gamma dosimeter employing a poled ferroelectric as the transducer element was studied. Irradiation with gamma rays causes a release of charge by the ferroelectric element. The magnitude of the charge released was determined experimentally to vary linearly with gamma dose. The current in a shunting resistor with no external voltage applied varies linearly with gamma dose rate. A constant of proportionality of 10^{-12} coulomb per rad (H_2O) per cm^2 of electroded ferroelectric surface was measured for polycrystalline $Pb(Zr_{0.65}Ti_{0.35})O_3$ + 1 wt % Nb_2O_5 irradiated in the Sandia Pulsed Reactor. The contribution to the charge release from the neutron irradiation was determined experimentally to be negligible. Irradiation in the 0.6 Mvp flash x ray also produces a linear relation between current and gamma dose rate. A similar release of charge was observed in poled ceramic barium titanate. (auth)

31915 (TID-18567(App.III)) FAST COINCIDENCE CIRCUITS FOR ANGULAR CORRELATION MEASUREMENTS. T. Hayashi (Ohio State Univ. Research Foundation, Columbus). 4p.

Coincidence circuitry used to amplify and detect the output signals from scintillation counters used in beta decay spectral studies are shown. The pulse shaping circuit and phase inverter are shown separately. (R.E.U.)

31916 (TID-20850) CYCLOTRON SPACE CHARGE LIMITS. K. R. MacKenzie (California. Univ., Los Angeles). May 1964. Contract AT(11-1)-34. 31p.

It is shown that the ion density in the beam at small radii limits the output of cyclotron, even f-m cyclotrons. Space charge spreads the beam and causes a vertical loss that, in the case of slit and puller sources, can be as severe as the inverse fourth power of the radius. Correspondingly, the useful beam varies inversely as the fourth power of the effective radius where the ions first encounter large magnetic focusing forces. For open sources this dependence drops to the inverse square. For either type of source the useful internal beam is found to vary as the cube of the gain per turn. Synchrocyclotrons capture a small fraction of the space charge limited beam at small radii. Even though the f-m rate must increase

with voltage, it appears that the capture beam still varies as the cube of the gain per turn. Experimental configurations are presented. Some suggestions are made for greatly increasing the output of cyclotrons, especially f-m cyclotrons. (auth)

31917 (UCRL-10907) NEUTRON DOSIMETRY NEAR A BARE PULSED REACTOR. Richard L. Lehman, Hiroaki Akagi, and Olga M. Fekula (California. Univ., Berkeley. Lawrence Radiation Lab.). July 15, 1963. Contract W-7405-eng-48. 35p.

Nuclear track emulsion was exposed in and around human phantoms to pulsed ^{235}U fission neutrons at the outdoor burst site of the Sandia Pulsed Reactor Facility at Albuquerque, New Mexico. The phantoms were located at distances from 10 to 200 m from the reactor. Tracks in the developed emulsions were scanned in order to obtain the local differential proton track energy spectra at 10 locations in and around the phantoms. From this was calculated the local absolute differential tissue dose, the local thermal (n,p) tissue dose, and the local fast-neutron energy spectrum. The maximum and minimum tissue proton doses in rads per 10^{18} fissions were found to be 330 and 33 at 10 m, 45 and 5.9 at 25 m, 2.6 and 0.46 at 100 m, and 0.58 and 0.076 at 200 m. (auth)

31918 (UCRL-11209(Rev.)) AUTOMATIC DIGITIZATION OF SPARK CHAMBER EVENTS BY VIDICON SCANNER. Sypko W. Andreae, Frederick Kirsten, Thomas A. Nunamaker, and Victor Perez-Mendez (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1, 1964. Contract W-7405-eng-48. 19p. (CONF-560-4)

From Conference on Film-Less Spark Chamber Techniques and Associated Computer Use, Geneva, Mar. 1964.

A system for the direct recording of track positions in spark chamber experiments is described. The system uses a Vidicon television camera as the digitizing device, which records the track positions in digitized form. This information, as well as that received from other electronic devices is an experiment, is held temporarily in a core storage and subsequently transferred onto magnetic tape in a format suitable for further analysis by computer. UCRL-11209 appears as CERN 64-30, p. 65. (auth)

31919 (JPRS-25068(p.1-15)) MEASUREMENT OF SMALL VALUES OF RADIOACTIVITY ON EXPEDITIONS. K. A. Kotlyarov and L. M. Khitrov. Translated from Okeanologiya, 4: 213-22(1964).

A 4-π-gas proportional counter was developed for use in the measurement of low-activity β particles. Design features and circuits are described and illustrated. The instrument gave good performance when operated in a stationary laboratory and during prolonged sea expeditions where it gave a highly reliable operating performance for the measurement of ^{90}Sr, radioactive rare earths, and naturally occurring ^{10}Be in samples of fresh water, sea water, suspensions, silts, and marine plants and animals. (C.H.)

31920 A GALVANOMETRIC SYSTEM FOR THE HIGH PRECISION STABILIZATION OF THE CURRENT IN THE THIN LENS BETA-RAY MAGNETIC SPECTROMETER. Mieczyslaw Subotowicz, Jan Kuranc, and Edward Krupa. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, Sect. AA, 17: 1-6(1962).

A standard resistor is connected in series with the coils of a magnetic beta spectrometer. The voltage across this resistor is compared with a reference voltage by means of a precise potentiometer. Any voltage changes in the main circuit, owing to current generator instabilities or thermal drift, are amplified by a d-c amplifier, whose output controls a current compensator. The circuit described is found to hold the coil current stable within 0.014% over a 4-hr period. (T.F.H.)

31921 INFLUENCE OF THE ADMIXTURE OF ARGON ON THE CHARACTERISTICS OF GEIGER-MÜLLER COUNTERS FILLED WITH A MIXTURE OF NEON AND ETHYL ACETATE OR WITH NEON AND AMMONIA. Antoni Malicki and Jacek Miczynski. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, Sect. AA, 17: 7-14(1962).

The effects of Ar admixtures with partial pressures up to 10 torr on the operating characteristics of G-M tubes filled with ethyl acetate–Ne mixtures (total pressure 80 torr) or NH_3–Ne mixtures (total pressure 100 torr) are studied. The parameters investigated as functions of the filler-gas composition are the starting potential, the width of the G-M plateau, and the slope of the plateau. (T.F.H.)

31922 SPECTROMETRIC SILICON DETECTORS POSSESSING A BROAD REGION OF SENSITIVITY. O. A. Matveev and S. M. Ryvkin. At. Energ. (USSR), 16: 356-9 (Apr. 1964). (In Russian)

A novel, n–i–p type counter was developed at the Physical Institute of the USSR Academy of Sciences. The counter is provided with a 2-mm thick sensitive layer, making it possible to measure with high accuracy the energy of β-particles, γ-quanta and of heavy particles possessing a long free path, such as protons, deuterons and high-energy α-particles. The detector consists of a disc of single crystal Si composed of n and p layers which possess electronic and hole-type conductivity, respectively, and of an i layer, representing a region of specific conductivity with a low charge-carrier concentration and high specific resistivity. The thickness of the detector window, designed for the spectroscopy of long-range particles, does not exceed a few microns. At a voltage slightly above 10 v the pulse amplitude is changed only slightly but toward 100 v the resolution of the detector improves drastically. The detector must be cooled in order to reduce the noise. The optimum condition is reached at 50 to 100 v and a temperature from 190 to 210°K. Detectors with a surface of about 0.5 cm^2 were prepared for the purpose of reducing the noise even further; a resolution of 8 kev could be thus attained. When used for the detection of 5-Mev α-particles, the device exhibited a resolution of about 2%. (TTT)

31923 SPECTROMETRY OF HEAVY, INTERMEDIATE-ENERGY CHARGED PARTICLES, USING n-i-p′ TYPE SILICON DETECTORS. O. A. Matveev, V. P. Rudakov, and I. N. Serikov. At. Energ. (USSR), 16: 360-2(Apr. 1964). (In Russian)

Silicon detectors can be used only for the study of particles, the mean free path of which does not exceed about 100 μ; for particles possessing a higher energy, and therefore a longer free path, the sensitivity range of the instrument must be increased. This can be achieved by compensating the original acceptors in the Si by the drift of Li^+ ions in the electric field of the n–p transition. The resolution and the pulse-amplitude dependence on the energy was examined for the intermediate energy α-particles and protons in the cyclotron of the I. V. Kurchatov Institute. The detector was placed in the scattering chamber at an angle of 22° with respect to the direction of the primary beam, recording the ions scattered by Au or C targets, bombarded by 9.7-Mev protons and 39- and 25-Mev α-particles. In order to study the temperature dependence of the resolution, the detector was cooled to −70°C. The

recording system included a preamplifier, an amplifier, a multipler and a 256-channel analyzer and a generator. Tests with β-particles and γ-quanta indicated that the cooling improves the resolution. The electron–hole pair formation was found to be independent of the displacement in the range above 20 v and had identical values for both α-particles and protons. In the α-particle scattering studies peaks corresponding to the ground and the fourth excited states of ^{12}C were found while the proton spectrum exhibited 3 lines belonging to the ground and the first excited states of ^{12}C, the third being probably due to the scattering of protons on H. (TTT)

31924 A GERMANIUM-TYPE SPECTROMETRIC γ-RADIATION DETECTOR. O. A. Matveev. At. Energ. (USSR), 16: 362-3(Apr. 1964). (In Russian)

Because of their narrow sensitivity range and the need for cooling, the semiconducting detectors based on the n–p transitions in Ge have not been widely used. However, it is possible to create an n–i–p transition with a wide i range by compensating for the acceptor impurities with donor-type mobile ions, dispersed by n–p transitions. Such an n–i–p structure is more suitable for use as a spectrometric γ-detector than the Si detectors because of the higher order number of Ge. The efficiency of Ge detectors with respect to photo-absorption is expected to be about 20 times higher than that of Si detectors. The n–i–p type Si detectors require cooling within a wide sensitivity range when used for β- and γ-spectrometry but their high resolving power compensates for this inconvenience. The n–i–p type Ge is prepared from p-type Ge, containing a small amount (about 10^{16} cm^{-3}) of O; the n–p transition is carried out by means of the thermal diffusion of Li. The tension thus added to the n–p transition causes a drift of the Li^+ atoms toward the p region, compensating for the acceptors. The energy spectrum of the ^{137}Cs γ-quanta was determined at 77°K by means of such a detector with a resolution of about 6 kev. The resolution could be further improved by changing the geometry of the experiment. (TTT)

31925 LOW-INERTIA SILICON DETECTORS FOR PULSED X RADIATION. O. A. Matveev, S. M. Ryvkin, and D. V. Tarkhin. At. Energ. (USSR), 16: 363-5(Apr. 1964). (In Russian)

Semiconducting detectors based on n–p and n–i–p transitions in Si have been found useful for recording short-lived ($<10^{-7}$ sec) hard x-ray pulses with energies up to 1 Mev. The diffusion time of the charge carrier created by the irradiation and the drift time of the carrier in the electric field of the n–p transition charge depend on the inertia of the semiconducting n–p detector. Such a detector must possess good ohmic contacts, low resistance, low capacity, and low inertia. Use of materials possessing high specific sensitivity which are able to withstand high inverse tensions makes it possible to reduce the volume of the device. The requirement of low inertia is best satisfied by n–p transitions with a broad volume charge area, in which the slow process of the collection of the carriers by diffusion plays a small role, the time of collection being controlled by the faster drift of the carriers. Two such low-inertia detectors were prepared for use with x radiation; they included one based on the n–p transition in Si, prepared by the diffusion of the phosphor into the hole– type-conductivity Si possessing a specific resistivity ranging from 1000 to 3000 ohm cm, and a second device, based on the n–i–p transition in Si. The i–type conductivity was obtained by compensating for the original hole–type conductivity by the drift of the Li^+ ions in the n–p transition field. The inertia obtained was within the range from 10^{-7} to 10^{-8} sec, thus being close to the limiting value of Si. (TTT)

31926 NEUTRON DOSIMETRY BASED ON A "LONG" COUNTER. E. S. Frid, G. V. Miroshnikov, N. I. Slozhenikin, and V. V. Barchugov. At. Energ. (USSR), 16: 365-6 (Apr. 1964). (In Russian)

Motion of the BF_3 counters within the paraffin block reduces the recording efficiency toward neutrons; this effect is expected to be inversely proportional with the neutron energy. Previous studies indicated that by increasing the depth of location of a BF_3 counter within the paraffin block of a long counter it is possible to achieve an efficiency $\epsilon(E_n)$ similar to the dependence of the physical and biological dose on the neutron energy. Such experiments were carried out with standard 33-mm diameter and 350-mm long BF_3 counters. The $\epsilon(E_n)$ dependence was measured by shifting the counter within the paraffin block to depths of 6, 9 and 12 cm, using 0.024-, 0.2-, 0.8-, 3- and 14-Mev neutrons and by covering the ends of the counters with various thicknesses of paraffin discs. It was found that at the above depths and 0 to 2 cm thick paraffin layers over the sensitive areas, the functions of the physical and biological doses vs. the neutron energy agree quite satisfactorily within the 0.8- to 14-Mev range. A similar agreement was noted in the 0.024- to 14-Mev range at the same depths but using 4 and 6-cm thick paraffin layers. (TTT)

31927 THE USE OF SILVERACTIVATED METAPHOSPHATE GLASSES FOR THE DETERMINATION OF PERSONAL AND LOCAL DOSES OF GAMMA- AND NEUTRON-IRRADIATION. E. Piesch (Kernforschungszentrums, Karlsruhe, Ger.). Atompraxis, 10: 268-76(June 1964). (In German)

Phosphate glasses are considered especially suitable for the determination of an accumulated irradiation dose. Because of their sensitiveness to thermal neutrons the use of Yokota glasses in nuclear plants is possible only by special filtering. Therefore the sensitiveness in dose for thermal and fast neutrons of the Yokota glasses was determined. The RBE-dose-sensitiveness, in comparison to ^{60}Co γ radiation, was: $D_{th}:D_{\gamma}:D_f = 3.3:1:0.007$. A personal dosemeter is shown, which, in the range of +10%, indicates the sum of the doses from γ radiation and thermal neutrons (measuring range 50 mrem to 1000 rem). A double dosemeter was tested, which allows a separation of the γ dose from that part of dose induced by thermal neutrons (measuring range 50 mrem to 500 rem). Using the activation of the glass and the filters a dose of thermal neutrons may be determined in a range higher than 500 rem. For neutrons with an energy range from 0.025 ev to 8 Mev this double dosemeter with special arrangements of moderators is a sensitive local dosemeter, which shows approximately the correct RBE-dose (measuring range 1 to 1000 rem). (auth)

31928 DETERMINATION OF THE CHARGE OF IONIZING RELATIVISTIC PARTICLES BY MEANS OF A DELTA RAY COUNTER. Carlo Depietri, Gloria Lippini, and Rita Perilli Fedeli (Università, Modena, Italy). Atti, Seminar. Mat. Fis. Univ. Modena, 12: 163-71(1962-63). (In Italian)

The fact that the number N' of delta rays counted along the track of an ionizing particle is less than number N of delta rays effectively present because of the confusion of their trajectories is established. It was experimentally shown by counting the track of a relativistic particle with known charge that N', in opposition to N, does not increase linearly as a function of Z^2. By the use of statistical reasoning, the increase of N' was determined as a function of

Z^2. The curve obtained was compared with experimental data with satisfactory results. The necessity of considering this in order not to undervalue the charge of the ionizing particle was discussed. (tr-auth)

31929 ARRANGEMENT FOR THE AUTOMATIC DETERMINATION OF THE OPERATING CHARACTERISTICS OF A G-M COUNTER. J. Manca, D. Kollár, and A. Gajdoš. Automatizace (Prague), 6: 230-1(Sept. 1963). (In Slovak)

The following arrangement is used to determine the operating characteristics of a G-M counter. The counter is connected through a resistance to a high-voltage source; the voltage is increased continually from a minimum to an upper limit, over a span of above 800 v, by rotating a potentiometer with a small synchronous motor. Impulses from the G-M counter are fed through a condenser and amplifier to an integrator and recorded on a moving paper tape. Protective relays were built in, to prevent damage to the G-M counter by a sudden discharge and voltage surge. Disconnecting contacts were built in to keep the motor from overloading the potentiometer. This arrangement works satisfactorily and is useful for determining the operating voltage of G-M counters used for measuring anticoincidence radiation, or when counters are used in parallel. (OID)

31930 GAMMA SPECTRA IN PILES. G. Manent and J. Rastoin. Bull. Inform. Sci. Tech. (Paris), No. 82, 3-6 (Apr. 1964). (In French)

The problem of the determination of gamma spectra in piles is considered, and the most usual methods of dealing with this problem are given. (P.C.H.)

31931 CALORIMETRIC GAMMA FLUX MEASUREMENTS. F. Ayela, J. De Goer, G. Manent, and J. R. Puig. Bull. Inform. Sci. Tech. (Paris), No. 82, 7-13(Apr. 1964). (In French)

The advantages of calorimetric methods for in-pile gamma ray measurements have led many CEA laboratories to study and develop different types of calorimeters. After recalling general principles the main characteristics of each method are briefly given. (auth)

31932 AN IONIZATION CHAMBER FOR HIGH GAMMA FLUX. J. de Goer (Centre d'Etudes Nucleaires, Grenoble). Bull. Inform. Sci. Tech. (Paris), No. 82, 15-19(Apr. 1964). (In French)

An ionization chamber for high intensity gamma flux measurements in a high neutron flux was tested in the MELUSINE reactor and compared to the calorimeters used at the Grenoble Nuclear Center. (auth)

31933 GAMMA MEASUREMENTS. USE OF GLASSES AND PLASTICS. F. Ayela, Y. Droulers, and J. R. Puig. Bull. Inform. Sci. Tech. (Paris), No. 82, 21-3(Apr. 1964). (In French)

A study was made of the possibility of using glasses and plastic materials for in-pile dosimetry. In spite of their simplicity these methods are little used. A comparative table is given. (auth)

31934 USE OF SILICON DIODES FOR GAMMA FLUX MEASUREMENT. G. Manent. Bull. Inform. Sci. Tech. (Paris), No. 82, 27-9(Apr. 1964). (In French)

A silicon diode was used for in-pile gamma dosimetry. The detection principle and the practical method of use are presented. The doses measured varied from 10^4 to 10^8 r. (auth)

31935 THE USE OF DAMAGE DETECTORS FOR SHIELDING RESEARCH. P. Dulieu and J. Rastoin. Bull. Inform. Sci. Tech. (Paris), No. 82, 47-51(Apr. 1964). (In French)

The interest of damage detectors for experimental reactor shielding studies is outlined. The general features of these detectors and the problems involved in their utilization are briefly examined. (auth)

31936 NEUTRON DOSIMETRY IN SPACE. D. Chol, J. P. Noel, and R. Schuttler. Bull. Inform. Sci. Tech. (Paris), No. 82, 53-6(Apr. 1964). (In French)

A study of the origin and importance of neutrons liable to cause trouble during space flights showed that the most important in this respect are those resulting from interactions between protons and the capsule itself. The study made use of various types of spectrometers according to the energy range of the neutrons. Research was also made on dosimeters that could be used easily on board space vehicles and that would give directly the dose inside the vehicle. (auth)

31937 CONVENTIONAL ELECTRONIC DETECTORS. A. Blanc. Bull. Inform. Sci. Tech. (Paris), No. 82, 75-9 (Apr. 1964). (In French)

Neutron detectors that consist of a neutron-charged particle converter associated with a standard electronic detector are described. For each case considered (ionization chamber, counter, scintillator) the performances obtained are given for counting (efficiency, maximum count rate, γ rejection) and, when necessary, for energy or time analysis. The most suitable field of application of each instrument is given. (auth)

31938 BF_3 COUNTERS— BORON CHAMBERS, CONVENTIONAL FISSION CHAMBERS, AND SEMICONDUCTOR FISSION CHAMBERS. Campan, Duchene, Gourdon, and Schuttler. Bull. Inform. Sci. Tech. (Paris), No. 82, 81-7 (Apr. 1964). (In French)

In a discussion on ionization detectors for the measurement of in-pile neutrons, the essential characteristics of instruments available in industry or produced in the CEA laboratories are summed up, together with the trends of detectors now being investigated. However, associated electronic equipment is not included. (P.C.H.)

31939 THE ADVANTAGE OF 4π β MEASUREMENTS. J. L. Campan, A. Charbonnel, A. Cottin, Y. Le Gallic, and M. Thierry. Bull. Inform. Sci. Tech. (Paris), No. 82, 89-91(Apr. 1964). (In French)

A 4π counter can be either a gas counter operating as a G-M or in the proportional region, or else an assembly of scintillators. For a greater number of bodies than in the coincidence method the measurements may be carried out with the 4π counter. A great problem however is self-absorption in the active source. The 4π technique is used in different ways for neutron flux measurements: the detector may be in the form of a thin film or a powder film. (auth)

31940 ENSEMBLE FOR COINCIDENCE COUNTING. J. Czerny (Centre d'Etudes Nucleaires, Grenoble), A. Gandy, J. Comera, and Y. Le Gallic. Bull. Inform. Sci. Tech. (Paris), No. 82, 93-6(Apr. 1964). (In French)

The principles of radioactive determinations using coincidence methods are summarized, stress being laid on the corrections necessary. A review is then made of various types of coincidence equipment used by the CEA, and their differences are pointed out. The expected accuracy is given for each type, as well as the range within which it may be used. (auth)

31941 ANALYZERS FOR SPECTROMETRY. Grimont and Raoult. Bull. Inform. Sci. Tech. (Paris), No. 82, 97-105(Apr. 1964). (In French)

The main features of the single or multichannel analyzers used for spectrometry by the French Atomic Energy Commission are summarized. Mention is also made of equipment now being developed. (P.C.H.)

31942 RECORDING NEUTRON FLUX ON TAPE AND WIRE. A. Charbonnel, H. Derrien, and A. P. Schmitt. Bull. Inform. Sci. Tech. (Paris), No. 82, 107-10(Apr. 1964). (In French)

The reasons for the construction of equipment for recording neutron fluxes on tape and wire are given. The main features of three models developed and built by the C.E.A. are described (2 types recording on tape and one on wire). (P.C.H.)

31943 ARRANGEMENT FOR CONTINUOUS MEASUREMENT OF IN-PILE NEUTRON FLUX. G. Pleyber. Bull. Inform. Sci. Tech. (Paris), No. 82, 111-13(Apr. 1964). (In French)

A study was made of continuous neutron flux measurements using a gas flow. Two experiments are described: one concerning slow neutron flux measurements using argon and the other fast neutron flux measurements using Freon. The two experiments were performed in swimming-pool reactors. (auth)

31944 COUNTING EQUIPMENT USING ACTIVATION DETECTORS. J. Brisbois, M. Lott, and G. Robin. Bull. Inform. Sci. Tech. (Paris), No. 82, 115-18(Apr. 1964). (In French)

An installation for counting based on activation detectors is made up of a certain number of measurement lives that are generally brought into action automatically. A description is given first of the measurement lives usually used and then of the logical organization of these elements. Finally it is shown that it is possible to use various counting procedures specially adapted to the nature of the experiment. (auth)

31945 THE CHANCE COINCIDENCES RESULTING FROM THE BOMBARDMENT OF A TARGET BY A VARIABLE BEAM. Abdelmalek Guessous (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Compt. Rend., 258: 5851-4(June 15, 1964). (In French)

The mathematical expectation of the number of chance coincidences for any intensity i(t) of the incident beam was determined. The dead time was taken into consideration. (tr-auth)

31946 GENEVA WHOLE-BODY COUNTER. II. CALIBRATION FOR NATURAL POTASSIUM AND VARIATION OF THE CONCENTRATION OF NATURAL POTASSIUM AS A FUNCTION OF THE WEIGHT OF THE SUBJECT. Pierre Wenger and Kyriacos Soucas (Center of Radioactive Medicine, Geneva). Helv. Chim. Acta, 47: 947-51(1964). (In French)

The Geneva whole-body counter was calibrated for potassium measurements by using a ^{42}K standard solution and natural potassium. Energy bands 250 kev wide were selected from 1335 to 1585 kev as the ^{40}K photopeak band and from 1375 to 1625 as the ^{42}K photopeak band. The measurements made on eight cases yield a calibration factor of 0.541 ± 0.023 cpm/g of natural potassium in the body. The variation of the amount of natural potassium with the body weight was also studied. The figures obtained for men and women gave the following least mean square straight lines: $y = 1.145\,x + 61.48$ (men) and $y = 0.471\,x + 68.93$ (women) where y = g of natural potassium and x = body weight in kg. (auth)

31947 RESPONSE OF PARALLEL-PLATE ION CHAMBERS TO RADIATION PULSES. Peter M. Livingston (Air Force Weapons Lab., N. Mex.). J. Appl. Phys., 35: 2341-8 (Aug. 1964).

A procedure for uncoupling the charge transport and electric field equations under certain restrictions of dose-rate limitation and no recombination in a parallel-plate ion chamber is given. A solution to the first uncoupled transport equation for a flat-topped ionization pulse, including diffusion, is obtained by finding the appropriate Green's function, and the subsequent current densities and external circuit current are derived. The usual assumption of neglecting diffusion is shown to be valid for most cases involving ion transport by an examination of the general form of the external chamber current. Variations of the external circuit current with the radiation pulse width and the ratio of negative to positive ion mobilities are given. An attempt to fit an observed record shows marked deviation of the decreasing portion of the signal from the calculated one. This is probably due to the cessation of an appreciable free electron current after irradiation not taken into account by the calculation. (auth)

31948 WHOLE BODY RADIOACTIVITY MEASUREMENT AND SIGNIFICANCE. G. E. Schifferdecker, W. V. Kessler, and J. E. Christian (Purdue Univ., Lafayette, Ind.). J. Pharm. Sci., 53: 269-72(Mar. 1964).

The total body potassium in humans was determined by measuring the ^{40}K radioactivity in a whole body liquid scintillation counter. These values were used to study the lean body mass and the fat content as a function of age and physical fitness. The effect of an anorectic-tranquilizer drug combination and food substitute therapy on the body composition of obese humans undergoing weight loss was also investigated. The techniques reported for the in vivo, nondestructive detection and measurement of low levels of γ-emitting radionuclides in large animals and man has opened up entirely new opportunities for research of significance to the pharmaceutical sciences, which heretofore was not possible. (auth)

31949 CONTRIBUTION TO THE STUDY OF SCINTILLATION GELS. STUDY OF THEIR BEHAVIOR IN A FLUX OF 14-Mev NEUTRONS. L. Commanay, A. Godeau, J. C. Jauregui, and C. Malesset. J. Radiol., Electrol. Med. Nucl., 45: 155-8(Mar.-Apr. 1964). (In French)

The behavior of scintillation gels irradiated with ^{60}Co gamma rays or fast neutrons was studied. An attempt was made to determine the optimum conditions for the use of these gels in the dosimetry of ionizing radiations. The gels obtained from aluminum stearate and aluminum octoate were compared to determine the effect of concentration and the setting temperature on their response. The setting temperature affects the pulse height, which explains the better stability of aluminum stearate. Irradiation with neutrons in geometrically different vats showed the affect of geometry on the spectra of recoil protons. It is concluded that scintillation gels can be used conveniently for the dosimetry of gamma radiation and fast neutrons. (auth)

31950 THE FAST NEUTRON DOSE AS FUNCTION OF LINEAR ENERGY TRANSFER OF RECOIL NUCLEI IN TISSUE. H. Rossbach, H. Abel, and K. Regel (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 319-24(May 1964). (In German)

A new dosimeter was developed that determines the dose as a function of linear energy transfer. On the basis of calculated linear energy transfer distributions for the first-collision dose for monoenergetical neutrons, the effects of the wall material on the shape of the linear energy transfer spectra are discussed. The principles, construction, operation, performance, and applications of the dosimeter are

described and illustrated on the example of first collision dose determination as a function of linear energy transfer for plexiglas (polyacrylic proprietary plastic). (OTS)

31951 AN IONIZATION CHAMBER FOR FAST NEUTRON SPECTROMETRY. H. Oehler, H. Koehler, and H. Pose (Technische Universität, Dresden). Kernenergie, 7: 325-32(May 1964). (In German)

The ionization chamber described is spherical and is equipped with a grid electrode. By utilizing the recoil-proton principle, it is capable of measuring neutron energies up to approximately 3 Mev. The use of the grid electrode contributes to a superior energy-resolving ability. The construction, operation, and performance of device is described and illustrated on the example of the examination of NA-24/Be photoneutrons. (OTS)

31952 CHECKING OF THE CAPACITY OF APPARATUS OF THE PM-1-M TYPE. R. S. Milshtein (Research Inst. of Radiology, Ministry of Public Health, USSR). Med. Radiol., 9: No. 4, 51-3(Apr. 1964). (In Russian)

The specificity of the scheme of the apparatus input is such that the existing checking of the instrument for the zero-point shifting is insufficient. An apparatus meeting the technical requirements with regard to the zero-point shifting could measure the dose with such a wide error range, that the measurements lose their value. Considering the features peculiar to the input, an additional checking, which would confirm the accuracy of the apparatus, is recommended. (auth)

31953 CALORIMETRIC MEASUREMENTS OF IONIZING RADIATION. 3. ON THE ENERGY FLUX IN COBALT-60 GAMMA-RAY BEAMS. Y. Takaku, K. Kawashima, T. Inada, K. Hoshino, S. Sakata, and H. Matsuzawa (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 316-19(July 25, 1962). (In Japanese)

The γ-ray output of a ^{60}Co teletherapy unit was measured by the calorimetric method. The experimental value of energy flux or intensity per r, Ef, was estimated at 3340 ± 160 erg/cm^{2}r. On the other hand, the calculated value of Ef was 3250 erg/cm^{2}r for average energy of 1.21 Mev, which is ~3% less than that obtained experimentally. Studies of the attenuation of ^{60}Co γ rays in Cu or MIX P (a tissue equivalent phantom material) were made by determination of energy flux density in the beam measured by a calorimeter and exposure dose rate measured by an ionization chamber. It was shown that the percentage transmission agreed for both methods of estimation. (BBB)

31954 ABSORBED DOSE MEASUREMENTS OF HIGH ENERGY RADIATIONS USING A FERROUS SULFATE DOSIMETER. Kenji Takeshita (Kyushu Univ., Fukuoka, Japan), Seiichi Yoshimoto, and Shigetoshi Antoku. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 288-9(June 25, 1963). (In Japanese)

The Fricke ferrous sulfate dosimeter was used to measure the absorbed dose of 200-kvp x rays, ^{60}Co γ rays, and 15-Mev x rays. The ratio of the absorbed dose of the ferrous sulfate to the r value read in the Victoreen thimble chamber, which was in a condition of equilibrium for the secondary electrons, was 0.95 ± 0.03 for 200-kvp x rays, 0.96 ± 0.04 for ^{60}Co γ rays, and 1.01 ± 0.03 for 15-Mev x rays of the Betatron. It is proposed that this value for the radiation above 3 Mev be called the r-equivalent (r-eq) as against the r-unit for the conventional x rays energies. (BBB)

31955 A TRANSISTORIZED SPECTRUM STABILIZER. K. Fricke and J. Nitschke (Technische Hochschule, Braunschweig, Ger.). Nukleonik, 6: 115-19(May 1964). (In German)

A completely transistorized spectrum stabilizer with large control factor (about 500) and large control range is described. A 500-Hz square-wave voltage is used for wobbling of the differential discriminator. The amplification of the direct-current control amplifier is 10^3 and highly constant. The theoretical and experimental determination of the control factors is given. (tr-auth)

31956 SPARK CHAMBERS: PRESENT STATE OF DEVELOPMENT. A. Roberts (Argonne National Lab., Ill.). Onde Elec., 44: 328-41(Apr. 1964). (In French)

Since the introduction of spark chambers in the field of high-energy physics, they have undergone many improvements and numerous types having become available. The theory, characteristics, and operation of spark chambers giving a visualization analogous to the path of the particle and those giving either a partially or completely digital representation are examined. (J.S.R.)

31957 LITHIUM FLUORIDE THERMOLUMINESCENCE DOSIMETRY. C. J. Karzmark (Hammersmith Hospital, London), John White, and J. F. Fowler. Phys. Med. Biol., 9: 273-86(July 1964).

Commercially available lithium fluoride thermoluminescent powder was studied with a specially built readout device. Glow curves were recorded against temperature, and the area under them was integrated. A dispenser to deliver 30 mg batches of powder with a precision of 1% was built. Factors investigated were tribothermoluminescence; reprocessing by annealing; photomultiplier gain variation and fatigue effects; response dose curves over the range 0.3 to 10^7 rad; dose-rate dependence over the range 5×10^2 to 2×10^8 rad/sec; accumulation of damage with increasing dose; comparative response of powders to x rays and fast neutrons; and the effect of fusing microcrystalline powder into a single small block. It is concluded that for doses of 1 to 10^5 rad the LiF system provides a compact, convenient system possessing wide dose-rate independence. The change in sensitivity, after doses of 3×10^4 rad were accumulated, requires that each batch of powder should be kept separate, and calibrated before use. The standard deviation for four to six 30 mg measurements from the same sample of powder varied from 1 to 6% but increased rapidly at doses below 3 rad. The use of LiF dosemeter as a transfer dosimetry standard is attractive for quick, convenient intercomparison between two laboratories. (auth)

31958 STANDARDIZATION OF IONIZATION CHAMBERS FOR MEGAVOLT X-RAYS. G. P. Barnard (National Physical Lab., Teddington, Middx., Eng.). Phys. Med. Biol., 9: 287-94(July 1964).

Experimental problems involved in determining reference standards and procedure for very high energy x or γ rays (above 2 Mev) are discussed. For a satisfactory solution of some of the problems in ionometric dosimetry more experimental information is required on broad beam attenuation, state of particle equilibrium and stopping power for electrons including the polarization effect. (auth)

31959 STUDIES OF CAVITY IONIZATION CHAMBERS WITH MEGAVOLTAGE X-RAYS. G. P. Barnard, A. R. S. Marsh, and D. G. I. Hitchman (National Physical Lab., Teddington, Middx., Eng.). Phys. Med. Biol., 9: 295-319 (July 1964).

Work undertaken and the experimental equipment used in an extensive program on many kinds of cavity ionization chambers used with 4, 6, 8, and 15 Mev linear accelerators

is described. The analytical studies reported refer only to graphite chambers. Functions were derived applicable to photon energies in the range 0.03 to 15 Mev, whereby the broad beam attenuation and state of particle equilibrium may be determined for graphite cavity chambers having a wide range of wall thicknesses. The relevance of the new data to various studies of immediate interest is examined. Stopping power problems in the energy range quoted are also discussed. Overall correction factors are determined for exposure measurements with graphite cavity chambers used with some x- and γ-ray sources in the photon energy range 0.03 to 15 Mev. (auth)

31960 DOSE-EXPOSURE CONVERSION FACTORS FOR MEGAVOLTAGE X-RAY DOSIMETRY. G. P. Barnard (National Physical Lab., Teddington, Middx., Eng.). Phys. Med. Biol., 9: 321-32(July 1964).

It is supposed that a commercial cavity ionization chamber fitted with its Perspex build-up cap, as required for a 2-Mv x-ray exposure calibration, is centered at a specified depth in a tissue-like phantom for a dose determination. The source of radiation may be an x-ray source in the range 2 to 15-Mv or a γ-ray source ^{137}Cs or ^{60}Co. However, the scale of the associated measuring instrument is determined by the 2-Mv x-ray exposure calibration. Hence, a reading in units of 2-Mv x-ray roentgens is always given, irrespective of the situation of the chamber and the source of radiation used with the phantom. The problem presented is how to convert a scale reading in units of 2-Mv x-ray roentgens to a scale reading in rads for a particular phantom material and a particular x- or γ-ray source. These computational problems are examined. An expression is derived for the required conversion factor. It is shown that these conversion factors are not critically dependent on the composition of the medium for low-Z materials or on small changes in the dimensions of the cavity chambers. The calculations refer mainly to a typical 0.6 cm^3 Baldwin-Farmer chamber; but some results are given also for a Victrometer chamber. (auth)

31961 ON THE CONGRUITY OF N.P.L. EXPOSURE STANDARDS. G. P. Barnard, G. H. Aston, A. R. S. Marsh, and Kathleen Redding. Phys. Med. Biol., 9: 333-44 (July 1964).

In the use of a graphite cavity chamber as a national reference standard for 2-Mv x rays, the roentgen realized for 2-Mv x rays must be consistent with the roentgen realized for, say, 250-kv x rays by the use of a standard free-air chamber as a national reference standard for medium energy x rays. The work undertaken to assess the extent of agreement between the two sets of reference standards is described. For obvious reasons, it is not possible to use existing standard free-air chambers to measure exposure with 2-Mv x rays; but it has now become possible to use a graphite cavity chamber to measure exposure with 250-kv x rays. The results of independent measurements by the cavity chamber and the free-air chamber may thus be compared. However, the analytical studies of graphite chambers reveal that with 250 kv x rays more than 90% of the total ionization arises from photon absorption in an inner skin about 0.001 in. thick surrounding the cavity. Hence, very special precautions have to be taken to avoid contamination of the inner wall of the chamber. Contamination due to dust from the wear of steel tools, that would be quite insignificant with 2-Mv x-rays, can have a profound effect on the behavior of the chamber when it is used with 250-kv x rays. A clean graphite chamber was constructed with diamond and ceramic tools. In spite of uncertainties about the x-ray spectrum used, it is shown that with 250-kv x rays the exposure standards are consistent to within ±1%. (auth)

31962 PULSE-SHAPE DISCRIMINATION ON THE GAMMA-RAY PULSES FROM $F^{19}(d,n\gamma)Ne^{20}$ OBSERVED WITH A LITHIUM-DRIFTED GERMANIUM GAMMA-RAY SPECTROMETER. T. K. Alexander, J. D. Pearson, A. E. Litherland, and C. Broude (Chalk River Nuclear Labs., Ontario). Phys. Rev. Letters, 13: 86-8(July 20, 1964).

It is shown that the technique of pulse-shape discrimination can improve the high-energy gamma spectra from lithium-drifted germanium detectors by reducing the background while still maintaining the intrinsic efficiency for the $(E_\gamma - 2m_0c^2)$ peaks. (L.B.S.)

31963 SEMICONDUCTOR RADIATION DETECTOR. PART II. Wataru T. Miyao (Keio Univ., Japan). Proc. Fujihara Mem. Fac. Eng. Keio Univ. (Tokyo), 15: No. 2, 57-65(Mar. 1964).

A p-n junction type semiconductor detector is described. By a shallow diffusion of phosphorus into p-type silicon wafer, a p-n junction detector was manufactured. The characteristics of the detector as an alpha-particle spectrometer were measured. Since the characteristics of the detector depend on surrounding conditions, i.e., the temperature, the humidity, etc., the effects of these factors were investigated. The p-n junction detector must be operated in dark and dry surroundings and below room temperature. (auth)

31964 FAST NITROGEN LIGHT SOURCE. Lloyd Mancebo (Univ. of California, Livermore). Rev. Sci. Instr., 35: 968-70(Aug. 1964). (UCRL-7422)

A submicrosecond flash lamp with a megalumen output was developed for calibrating scintillation detectors in the field. When operating at 6 kv, a 50-nsec pulse is produced with jitter less than 10 nsec. The output is centered about 3600 Å and is 1000 Å wide. (auth)

31965 CURLED LIGHT PIPES FOR THIN ORGANIC SCINTILLATORS. William A. Gibson (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 35: 1021-3(Aug. 1964).

A technique is described for heat bending light pipes from rectangular sheets of plastic. The method is useful for coupling organic scintillators with a thickness less than $\frac{1}{4}$ in. and a few inches wide to 2-in. photomultipliers. Quantitative comparisons of these light pipes with a light pipe machined from a solid block of plastic are described. The results show good light transmission is easily attained with the "curled" pipes. (auth)

31966 CALIBRATION OF 30-cm FARADAY CUP. J. N. Palmieri (Oberlin Coll., Ohio and Harvard Univ., Cambridge, Mass.) and R. Goloskie. Rev. Sci. Instr., 35: 1023-6(Aug. 1964).

A Faraday cup which was used as an absolute monitor in several experiments performed was calibrated indirectly against a counter telescope in the direct cyclotron beam. The Faraday cup was found to be only 95% efficient at 160 Mev, indicating that some values of differential cross sections reported earlier are about 5% too large. (auth)

31967 SPARK CHAMBER AND MAGNET SYSTEM FOR PHOTOGRAPHING COSMIC-RAY TRACKS AT BALLOON ALTITUDES. James A. DeShong, Jr. (Argonne National Lab., Ill.), Robert E. Daniels, Roger Hilderbrand, and Peter Meyer. Rev. Sci. Instr., 35: 1035-9(Aug. 1964).

A detection system consisting of five spark chambers and a deflection magnet is described, which was used to photograph cosmic beta particle tracks at 130,000 ft. Four trajectory spark chambers display the deflected particle track from which particle energy and sign may be deter-

mined. A tantalum-plate spark chamber at the exit detects electrons by production of cascade showers. (auth)

31968 MEASUREMENT AND CONTROL OF THE MAGNETIC FIELD IN A BETA SPECTROMETER. A. A. Bartlett, Howard Shafer, and J. R. Keith (Univ. of Colorado, Denver). Rev. Sci. Instr., 35: 1072(Aug. 1964).

A system for precise determination of the field cancellation and for automatic control is briefly described. (D.C.W.)

31969 CHLORINE-NEON GEIGER-MÜLLER COUNTERS WITH ENERGY-INDEPENDENT GAMMA-RAY EFFICIENCY. Vitaly Danchenko and Nicolas Mitrofanov (Univ. of Maryland, College Park). Rev. Sci. Instr., 35: 1076-7 (Aug. 1964).

A G-M tube with a high and almost ideally flat efficiency response curve in the gamma energy range from 0.39 to 1.30 Mev was developed. The tube was machined from Be and was filled with a Cl–Ne mixture. (D.C.W.)

31970 LOW VELOCITY DRIVE FOR MÖSSBAUER EXPERIMENTS. V. Vali and T. W. Nybakken (Boeing Scientific Research Labs., Seattle). Rev. Sci. Instr., 35: 1085-6(Aug. 1964).

A Doppler drive is described with which the velocity can be varied linearly from an amplitude of 1 to 10^{-3} cm/sec. The system has a very low random noise amplitude and is operable at liquid He temperature. (D.C.W.)

31971 DIMENSIONS AND STRUCTURE OF DEVELOPED GRAINS IN NUCLEAR EMULSIONS OF VERY FINE GRAIN. N. A. Perfilov, N. R. Novikova, and V. I. Zakharov. Zh. Nauch. i Prikl. Fotogr. i Kinematogr., No. 1, 62-3(1963). (In Russian)

The growth of the dimensions of grains during development was measured for three nuclear emulsions— P-9r, PR-2, and R-NIKFI. Values are presented for tracks due to electrons from ^{89,90}Sr, alphas from ^{210}Po, and fogging. Sample electronic micrographs show the different forms of the developed grains in a nonirradiated emulsion and in emulsions irradiated by electrons and by alpha particles. (M.J.T.)

31972 NUCLEAR RESEARCH EMULSIONS. VOLUME I. TECHNIQUES AND THEORY. Walter H. Barkas. Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 15. New York, Academic Press, 1963. 532p. $18.00.

Uses, physical and chemical compositions, processing before and after use, microscopy and scanning techniques, particle scattering, track structure, and ranges of particles in nuclear emulsions are discussed. A bibliography of books, conferences, and literature references is given. (R.E.U.)

31973 TRIGGERED NANOSECOND LIGHT SOURCE (Engineering Materials). (Univ. of California, Berkeley). (CAPE-1057)

Thirty-five drawings are included. For a listing of individual titles, see the Engineering Materials List (TID-4100). The nanosecond light source, which is based on a corona discharge started by field emission, is an attachment for scintillation counters. Individual light sources, placed to illuminate each phototube and fired by a pulse generator through splitting transformers and cable delays, facilitate the coincidence timing of an array of photomultiplier detectors. The system consists of a pulse generator, pulse splitting transformers, cable delays, and individual light sources. The electrical pulses are generated by switching a charged coaxial cable into an output transmission line of matched impedance of 51 ohms. A mercury capsule in a constant-impedance oil-filled enclosure is the switch. The input and output impedances of the splitting transformer are 51 ohms. Four equal and synchronous outputs are provided at just half the input voltage. One transformer feeds four others to produce 16 identical signals at one fourth the voltage level of the primary pulse generator. (P.C.H.)

31974 100 Mc DECADE SCALER (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). (CAPE-1116)

Five drawings are included. For a listing of individual titles, see the Engineering Materials List (TID-4100). The 100 Mc decade scaler is a new version of the 100 Mc scaler. It is much more reliable than previous models and divides by 10 instead of by 8. This package contains schematic drawings for the scaler, rate meter, and readout device. (P.C.H.)

31975 FUEL ROD SCANNER (Engineering Materials). (General Electric Co., Richland, Wash.). (CAPE-1098)

This package contains 7 drawings. For a listing of individual titles, see the Engineering Materials List (TID-4100). The gamma energy scanning system is designed to scan indicated fuel rods to determine burnup of the fuel material per increment of fuel length. (M.C.G.)

31976 A HIGH SPEED ANALOG PULSE DIVIDER. G. L. Miller and E. A. Gere (Bell Telephone Labs., Inc., Murray Hill, N. J.). 25p. (CONF-182-24)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

A high-speed analog pulse divider is described that is contained in a single transistor envelope. The divider uses a commercially available dual-emitter transistor. The response time is 250 nsec. Various characteristics of the divider are investigated. (T.F.H.)

31977 CIRCUIT ARRANGEMENT FOR THE MEASUREMENT OF THE DOSE OR DOSE RATE OF IONIZING RADIATION. Walter Schellenberger (to Physikalisch-Technische Werkstatten Dr. Pychlau K.G.). German Patent 1,165,770. Mar. 19, 1964. Filed Dec. 12, 1959.

The circuit arrangement consists of an ionization chamber, the collecting electrode of which is connected to the grid of an electron valve and to a condensor charged by the ionization current. The condensor is discharged by pulsed voltages, which are generated by short circuiting the resistor generating negatively biased voltage. For this purpose an electronic switch, e.g., a P-N-P transistor, is switched in parallel to the resistor. A simple circuit is described for feeding electric pulses to the control electrode of the electronic switch. (Gmelin Inst.)

31978 APPARATUS FOR THE MEASUREMENT OF PULSES FROM NUCLEAR RADIATION DETECTORS WITH AUTOMATIC DEAD TIME CORRECTION. Fritz Raux and Gerd Wolf. German Patent 1,165,771. Mar. 19, 1964. Filed Mar. 30, 1961.

A circuit arrangement processing detector pulses is provided with additional circuit members, e.g., electronic computers, which are able to compensate automatically for the dead-time losses during the measuring process with dependence on a predetermined dead time in such a way that the apparatus displays or registers the real pulse number for a preliminary chosen time interval. (Gmelin Inst.)

31979 METHOD FOR THE PRODUCTION OF SCINTILLATORS. James Frederick Bacon, Thomas Helmut Elmer, and Harrison Porter Hood (to Corning Glass Works). German Patent 1,165,772. Mar. 19, 1964. Priority date Sept. 4, 1958, United States.

Scintillators are produced of silicate glass using cerium as activator. The glass contains 96% silicic acid and is heat treated and soaked with acid. The porous glass body obtained is impregnated by dipping it into a solution of cerium salt, dried on air, and heated in an oxygen containing atmosphere until a non-porous body is obtained. (Gmelin Inst.)

31980 OPTICAL COUPLING OF A SCINTILLATOR TO A PHOTOMULTIPLIER. Roland Wester Carlson (to Harshaw Chemical Co.). German Patent 1,165,773. Mar. 19, 1964. Priority date July 6, 1960, United States.

The reflectors for the scintillators were arranged in such a way that light from scintillations, which are generated in portions of the scintillators from which a smaller part of the light falls directly upon the photocathode of the multiplier, is reflected stronger on the photocathode than light from such portions of the scintillators from which the scintillation light is falls directly on photocathode. This optical coupling is characterized by a reduction of the line width. (Gmelin Inst.)

31981 SCINTILLATION DETECTOR AND CIRCUIT FOR LOW-ENERGY RADIOACTIVE PLUTONIUM. Howard C. Eberline (to Eberline Instrument Corp.). U. S. Patent 3,139,527. June 30, 1964. Filed Apr. 18, 1961.

A detector for ^{239}Pu is described that exploits the characteristic 17-kev x ray and provides a resolution of 40 μsec. The detection system is made up of a NaI crystal, photomultiplier tube, and the necessary amplifiers. (R.E.U.)

31982 DIRECTIONAL GAMMA-RAY DETECTOR. Serge A. Scherbatskoy. U. S. Patent 3,140,395. July 7, 1964. Filed May 11, 1961.

A directional scintillation detection system is described that selectively records gamma spectra through two scintillation detectors of different sizes. (R.E.U.)

ISOTOPE TECHNOLOGY

General

31983 (BNL-848) FABRICATION OF BNL STANDARD COBALT-60 SOURCE. A. Oltmann and O. A. Kuhl (Brookhaven National Lab., Upton, N. Y.). Feb. 1964. Contract AT-30-2-GEN-16. 26p.

The BNL standard source is a cobalt-60 gamma irradiation source consisting of a strip of cobalt approximately 12 inches long which has been doubly encapsulated in stainless steel, once before activation and again after activation. A description is given of the procedures and equipment used in the preparation and fabrication of these sources to meet the specifications of the Savannah River Plant. (auth)

31984 LIMITATIONS ON THE USE OF ISOTOPES IN REACTION MECHANISMS. PART I. SOME GENERAL CONSIDERATIONS. S. V. Anantakrishnan (Madras Christian Coll., Madras). Current Sci. (India), 33: 297-9(May 20, 1964).

An appraisal of the validity of the method in the use of isotopes in deciding on a reaction mechanism is presented. (P.C.H.)

Industrial Applications

31985 (A/CONF.28/P/196) ADVANCES IN RADIOISOTOPE PRODUCTION AND UTILIZATION IN SCIENCE AND INDUSTRY. Paul C. Aebersold (Atomic Energy Commission, Washington, D. C.). 11p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Advances in the large-scale production of radioisotopes are described. Thermal applications of radioisotopes, preparation of large sources for radiation processing, radiation treatment of foods, tracer methodology and applications, isotope measurement and control systems, instrumentation improvements, and the future of radioisotope applications are discussed. (M.C.G.)

31986 (BNL-7397) THE USE OF LOW ENERGY RADIOACTIVE ISOTOPES IN THE EXAMINATION OF PAINTINGS ON THIN SUPPORTS. E. V. Sayre (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 17p. (CONF-576-1)

From Paper and Textile Supported Art Objects Symposium, New York, Nov. 1961.

A 0.5-mC ^{55}Fe source was constructed for the production of very soft x rays for the radiography of paintings. The source consists of a polyvinyl alcohol film containing ^{55}Fe, and the possible radiation hazards of handling this source are considered and found to be negligible. The application of the source is illustrated using two 18th century Japanese paintings, and comparisons are made with conventional radiographs. The disadvantages of ^{55}Fe are outlined. In a group discussion, other methods for the radiography of art objects are considered. (D.L.C.)

31987 (CONF-568-1) COMMERCIAL-SCALE PUSH TOWARD RADIATION PROCESSING. Joseph E. Machurek, George R. Dietz, and Martin H. Stein (Division of Isotopes Development, AEC). [nd]. 7p.

From the Conference on Industrial Applications of New Technology, Atlanta, Apr. 1964.

Commercial applications of radiation processing procedures are reviewed. Topics discussed include the use of radiation in the production of ethyl bromide; medical supply sterilization; the production of cross-linked polyethylene wire, tubing, and film; and the production of semiconductor components. Radiation processing procedures now under development for commercial use include procedures for the production of wood-plastic materials, food irradiation, and the curing of coatings. Radiation sources used include radioisotopes and electron accelerators. (C.H.)

31988 APPLICATION OF RADIOISOTOPES IN THE CHEMICAL INDUSTRY. W.-J. Schmidt-Kuster and H. Mohrhauer. Atomwirtschaft, 9: 263-4(June 1964). (In German)

In the chemical industry measuring processes based on the absorption or back scattering of ionizing radiations find extensive use for the measurement of thickness, surface weight, and density as well as for content level indicators and for the constituent analysis of mixtures. The cost of the necessary equipment is between about DM 6000 for a very simple on-off switching arrangement, e.g., for content level indicators, and about DM 80,000 for complicated installations for process control. Economic can be obtained in respect to personnel (by the introduction of a thickness measuring equipment, for example, one workman per shift), raw material (by reduction of tolerances), wastage (by more exact control), increases in productivity (by speeding up measurement and analysis procedures), earlier warning in the case of abnormal operating conditions, etc., and generally by the quality improvement resulting from these individual advances. The use of radioisotopes in tracer (indicator) techniques is widespread while the introduction of large sources for radiation chemistry is just beginning. (auth)

31989 RADIOISOTOPE ARRANGEMENT FOR MEASUREMENT AND REGULATION IN INDUSTRY. J. Oppelt. Automatizace, 6: 230-1(Jan. 1963). (In Czech)

Radiation transmission, reflection, ionization of surroundings, changes in the position of the radiation source, and the application of neutrons are discussed. Several types of apparatus (various ionization chambers, operational radiation shields, etc.), were developed and standardized and are offered in various arrangements and combinations to potential users. (OID)

31990 THE EFFECT OF IONIZING RADIATION ON THE COLOR AND FLAVOR OF FRUIT JUICES. J. Farkas, K. Vas, and I. Kiss. Kozp. Elelmiszeripari Kutatoint Kozlemen., No. 1, 1-10(1962).

The color of apple and black currant juices faded during irradiation. This fading was particularly conspicuous in black-currant juices, whose color is due to anthocyanins, which are very sensitive to irradiation. However, untreated black-currant juices also lost color after storage for prolonged periods. Apple juices contain anthocyanins only when produced from red apples; consequently, they are generally less sensitive to irradiation. The stability of color in extracts produced from red apple peels was considerably affected by the pH. Very low pH values had a stabilizing effect whereas pH values higher than the original caused spontaneous and rapid color degradation in the presence of air. Enzymatic browning was observed both in irradiated and in untreated samples. (OID)

31991 A NEW METHOD FOR DETERMINATION OF THE AMOUNT OF INFORMATION ON X-RAY RADIOGRAPHS. I. THE AMOUNT OF INFORMATION DERIVED FROM RADIATION ABSORPTION CURVES OR FILM DENSITY CURVES. Hitoshi Kanamori (Shimadzu Seisakusho Ltd, Kyoto). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 990-6(Dec. 25, 1962). (In Japanese)

Considering contrast alone, this method relates film densities to the thickness, x, of the material radiographed. The information obtainable is derived from such radiographic factors as features of x-ray generators, geometries from focus-to-film distances, kvp and ma-sec values, and characteristics of screen and film. If $a \leq x \leq b$ is needed for a diagnosis, where a and b are ranges of x values, the range can be normalized to $0 \leq X \leq 1$ by an equation, which is given, and the gradient g(x), which gives the contrast $g(x)\Delta x$ between x and $x + \Delta x$, is normalized to G(X) by another equation. This gradient G at the thickness X provides the information F(G). Its characteristics (i.e., $F(G) = 0$ and F(G) increases with G) give 3 possible functions. Considering $F(G) = G^n$, $(0 < n < 1)$, the simplest function, the total information available is represented by $\int_0^1 F(G)\,dX = \int_0^1 \{G(X)\}^n\,dX$, where $0 < n < 1$. This integral gives a maximum D_m^n, on the straight line between the two corners of the area $0 \leq X \leq 1$ by D_m, where D_m is the practical range of film density. The amount of information is defined by: $H = D_m^{-n} \int_0^1 \{G(X)\}^n\,dX$, $0 < n < 1$. H's are calculated from a table prepared from model curves. To fulfill $H_b > H_c$, n should be chosen as $\upsilon < n < \frac{1}{2}$. According to the definition used, $H \leq 1$. In practice, the calculation of the integral of H can be performed by numerical summations. Instead of film density, logarithmic radiation transmission may be used. Then, $E_m = D_m/\gamma$ takes the place of D_m. The optimum kvp can be determined as shown by an integration diagram. Experimental transmission curves and calculated H's are given, where E = 0.7. For inspecting a 3.65-mm Al plate, the optimum transmission curves, with a single-phase rectified, a 3-phase rectified type of generator, and by monochromatic x rays, are shown. The results show that homogeneous x rays give the best information, and that large rates of pulsation in tube voltage waveforms increase soft radiations and decrease the information obtained, at the low kvp's. (BBB)

31992 THE USE OF RADIOISOTOPES AND IONIZING RADIATION IN AGRICULTURAL RESEARCH. P. G. Marais. S. African J. Sci., 59: 319-24(July 1963). (In Afrikaans)

Applications of radioisotopes in agriculture and food research mentioned include tracers for soil analysis and fertilizer research using ^{32}P, autoradiography; radiocarbon in plant physiology, especially for studying assimilation; measuring ground water movement with ^{3}H and determining the moisture of the soil with a Ra–Be source, etc. In South Africa, the greatest interest was shown in the possibility of preserving fruit by γ irradiation. For this purpose, a 500-C ^{60}Co irradiation center was installed. With this high intensity radiation, male insects are sterilized so that insect pests can be eventually eradicated. High intensity radiation also gives the plant breeder a means for increasing greatly mutation frequencies and thus providing a much larger basis for selecting favorable mutants. (OID)

31993 PANORAMA OF THE APPLICATION OF NUCLEAR ENERGY IN AGRICULTURE. Felice Ippolito. p.1-22 of "Progresso Agricolo e Scienze Nucleari." Florence, Officine Grafiche Vallecchi, 1963. (RT/BIO(63) 49). (In Italian)

Basic applications of atomic energy to agriculture are summarized. In this review the program of C.N.E.N. in agriculture is inserted: the results achieved, the programs underway both in the field of research and in those of the installation of plants to be used by collectivity and of the training of personnel. The advantages, apparent or expectable, offered by the exploitation of nuclear energy on agricultural purposes are discussed. Ways by which C.N.E.N. intends to operate for the solution of the problems of the Italian agriculture, to which the application of nuclear energy might give a contribution are explained. (auth)

31994 VOPROSY FIZIOLOGII. TOM VI. (Questions of Physiology. Volume VI). A. I. Karaev, ed. Baku, Azerbaijan SSR, Publishing House of the Academy of Sciences, 1963. 170p.

Sixteen papers are included. Separate abstracts were prepared for two. Papers not abstracted are on effects of electrical, chemical, and physical stimulations on the functions of the brain, stomach, various glands, and nerves and on reflexes and blood composition in animals. (M.J.T.)

For abstracts of individual papers see: 31256 and 31257.

Power Application

31995 EMERGENCY AUXILIARY POWER FOR LONG DURATION MISSIONS. C. H. Shinbrot (Douglas Aircraft Co., Inc., Santa Monica, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-447, 7p. $1.00. (CONF-600-41)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Fuel cell systems, Stirling engine chemical systems, internal combustion engine systems, storage batteries, and isotope powered systems are evaluated as emergency auxiliary power systems for long duration missions on the basis of availability, performance, weight, radiator area, resupply requirements, and safety. (C.E.S.)

Separation and Production

31996 (A/CONF.28/P/290) PRODUCTION OF HEAVY WATER IN THE U. S. A. William P. Bebbington (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.), John F. Proctor, William C. Scotten, and Victor R. Thayer. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Operations (including performance, costs, efficiency, corrosion, safety, and reprocessing) and future economics of heavy-water-separating plants are reviewed. (T.F.H.)

31997 (ORNL-TM-804) SEPARATION OF ^{131}I, ^{132}I, ^{133}Xe, ^{103}Ru, ^{140}Ba, AND ^{140}La FROM REACTOR-IRRADIATED ^{235}U. Howard T. Russell (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 11p.

A method was developed for recovering curie quantities of fission-product ^{131}I, ^{132}I, ^{133}Xe, ^{103}Ru, ^{140}Ba, and ^{140}La from reactor-irradiated ^{235}U by a series of steps, including vacuum out-gassing, cold-trap fractionation, distillation, and precipitation. The products have radiochemical purities of 99 to 99.999%. (auth)

31998 (NP-tr-1155) DEUTERIUM AND TRITIUM SEPARATION FACTORS FROM ELECTROLYTIC EVOLU-

TION OF HYDROGEN. H. V. Buttlar, W. Vielstich, and H. Barth. Translated by Emilio J. Troianello (Northeastern Radiological Health Lab., Winchester, Mass.), from Ber. Bunsenges. Physik. Chem., 67: 630-7(1963). 25p.

Deuterium and tritium fractionation factors in the electrolytic evolution of hydrogen were measured for various electrode materials (Fe, Ni, Pt, Ag, Hg) and electrolytes (KOH, H_2SO_4) as a function of the overvoltage. In some systems, the effect of the nature of the surface was successfully eliminated. The dependence of the separation factor on the overvoltage is discussed. For each series of measurements the ratio ln S_T/ln S_D was independent of the overvoltage and nature of the surface. Values of this ratio varied between 1.29 and 1.53. Because of its high and reproducible separation factor a sintered electrode of iron and nickel in KOH is recommended for technical applications. (auth)

31999 (ORNL-tr-191) CONCERNING THE SEPARATION AND CONCENTRATION OF THE ARTIFICIALLY RADIOACTIVE SODIUM ISOTOPE $^{24}_{11}Na$. U. Drehmann. Translated by J. J. Pinajian (Oak Ridge National Lab., Tenn.), from Naturwissenschaften, 33: 24(1946). 4p.

The production of ^{24}Na by the $^{24}Mg(n,p)$ reaction was investigated. Analytical-grade MgO was found to be a good starting material as ~90% of the ^{24}Na is separated therefrom simply by boiling with water. More of the ^{24}Na could be separated by using the Schaffgottschen method. (D.L.C.)

32000 (ORNL-tr-230) A NEW METHOD OF SEPARATING ARTIFICIAL RADIOELEMENTS. J. Govaerts. Translated by J. J. Pinajian and Martha Gerrard (Oak Ridge National Lab., Tenn.), from Bull. Soc. Roy. Sci. Liege, 9: 38-40(1940). 4p.

The method is based on the difference in solubility of the irradiated material and the product nuclide in a solvent. The method is illustrated by the preparation of ^{42}K by the $^{42}Ca(n,p)$ reaction of $CaCO_3$ followed by boiling water treatment, and the preparation of ^{24}Na by the $^{24}Mg(n,p)$ and $^{27}Al(n,\alpha)$ reactions of $MgCO_3$ and Al_2O_3 followed by water treatment. (D.L.C.)

32001 GENERATOR FOR PRODUCTION OF ^{99m}Tc FROM IRRADIATED MOLYBDENUM. N. B. Mikheev, M. El Garhy, and Z. Moustafa (Atomic Energy Establishment, United Arab Republic). Atompraxis, 10: 263-4(June 1964).

A method for preparing a ^{99m}Tc generator using ^{99}Mo resulting from neutron-irradiated molybdenum is described. To prepare a generator of 10 mC activity 0.13 g of Mo was sorbed on chromatographic aluminum oxide. Elution of technetium was carried out by 0.05% solution of Br_2 in 0.01N HCl. (M.C.G.)

32002 SOME NEW DEVELOPMENTS IN THE PRODUCTION OF CARRIER-FREE ^{32}P. O. Z. Jovanovic-Kovacevic and P. M. Janicijevic (Inst. of Nuclear Science "Boris Kidrich", Belgrad). Atompraxis, 10: 265-7(June 1964).

Two procedures for the production of carrier-free ^{32}P were developed. These are: production by neutron irradiation of α-sulfur and production by neutron irradiation of $MgSO_4$. They have advantages over some earlier methods because they require fewer chemical operations and manipulations and are applied at relatively low temperatures. These facts make possible the use of simple equipment in which high yields of ^{32}P (78 to 83% in the extraction process and 85 to 95% in the adsorption process) are obtained. Both methods produce carrier-free ^{32}P in the form of $H_3{}^{32}PO_4$ with a chemical and radioactive purity suitable for biological and medical applications. (auth)

32003 HEAVY WATER FROM COAL?. Colliery Guardian, 208: 212(Feb. 14, 1964).

The collieries of northern France will be engaged in the production of heavy water from ammonia by a process based on an exchange of hydrogen isotopes between ammonia and hydrogen. This introduces a new economic factor to the coal fields. A large installation with an annual output capacity of 15 to 20 tons of heavy water and an ammonia factor are to be built at Mazingarbe. The latter will have a daily output capacity of 500 tons and represents the first step in a plan to rationalize its fertilizer production. (UKAEA Information Bulletin, No. 21, May 25, 1964)

32004 THEORETICAL CONSIDERATIONS ON THE PRODUCTION OF HEAVY WATER BY RECTIFICATION. J. L. Otero de la Gandara and J. R. Alvarez Gonzalez. Energia Nucl. (Madrid), 8: 26-37(Jan.-Mar. 1964). (In Spanish)

The use of distillation for the concentration of heavy water is discussed on the basis of theoretical considerations on the characteristics of the $H_2O-HDO-D_2O$ system, relative volatility of the three molecular species, and reflux relations. The method of calculation and the calculation of the pressure loss are given. (J.S.R.)

32005 POTENTIOSTATIC DETERMINATION OF ELECTROLYTIC HYDROGEN–DEUTERIUM SEPARATION FACTORS AND THE REACTION MECHANISM AT MERCURY AND PLATINUM. M. Salomon and B. E. Conway (Univ. of Ottawa). J. Phys. Chem., 68: 2009-12(July 1964).

Electrolytic hydrogen-deuterium separation factor (S) measurements were made under potentiostatic conditions in highly purified HCl and $HClO_4$ solutions in water containing 10 vol % D_2O. The separation factor at Pt was found to be a function of overpotential; the behavior observed depends on the nature of the anion of the electrolyte using HCl (aq) and $HClO_4$(aq). At Hg, the S values were significantly potential dependent and $dS/d\eta = 0.6\ v^{-1}$ for HCl (aq) while $dS/d\eta = 1.44\ v^{-1}$ for $HClO_4$ solution. At Pt the $dS/d\eta$ values are much larger, and depend on the anion of the electrolyte. For Hg, the mechanism of the h.e.r. is discussed in terms of two widely different rate-controlling mechanisms: the H_3O^+ ion discharge or the H_2^+ ion neutralization. (P.C.H.)

32006 SEPARATION OF STABLE ISOTOPES. III. METHODS BASED ON IRREVERSIBLE PROCESSES. Gh. Vasaru (Atomic Physics Inst., Chij, Romania). Rev. Chim. (Bucharest), 14: 474-8(1963). (In Romanian)

Use of thermal diffusion in separation of stable isotopes is discussed. The theory of effects of thermal diffusion is outlined. A thermal diffusion column is described, its parameters analyzed, and its operation discussed. Equations for thermal diffusion are given. (M.C.G.)

32007 METHODS FOR THE SEPARATION OF STABLE ISOTOPES. V. METHODS BASED ON IRREVERSIBLE PROCESSES. Gh. Vasaru (Inst. of Atomic Physics, Cluj). Rev. Chim. (Bucharest), 15: 156-9(Mar. 1964).

Stable isotope separation methods based on irreversible processes, namely, ion migration, electrolysis, and biological processes, are described. The results and possible uses of each method are presented. (46 references) (OTS)

32008 THE DEVELOPMENT OF Tl^{204} SOURCES FOR RADIOGRAPHIC TESTS. N. Jelić. Tehnika, 18: 1617-19 (Sept. 1963). (In Serbo-Croatian)

^{204}Tl can be produced according to the reaction, $^{203}Tl(n,\gamma)^{204}Tl$. In like manner, ^{206}Tl, which has a short half life of 4.2 min, can be produced according to the reaction, $^{205}Tl(n,\gamma)^{206}Tl$. Difficulties encountered in chemical methods of purification may be avoided by using pure metallic Tl in

order to obtain a radioactively pure source. The 99% pure Tl was cooled in order to measure the γ spectrum. A rapid exposure made demonstrated the higher source quality. (OID)

32009 RADIOISOTOPES AND THEIR INDUSTRIAL APPLICATIONS. H. Piraux. Eindhoven, Netherlands, Edition Centrex, 1962. 271p. (In French)

The nature of radioelements, physiological effects of radiation, action on material and protection, safety in work conditions, radiation detectors, auxiliary apparatus, and choice of isotope and detector for a particular application are discussed. Also considered are: physical applications of ionization; radioisotopes and chemistry; radioisotopes as tracers; thickness, density, and level measurements; gammagraphy and autoradiography; and other miscellaneous applications. (OID)

32010 IMPROVEMENTS IN OR RELATING TO METHODS AND DEVICES FOR DETERMINING THE MEAN RADIUS OF PORES IN MICROPOROUS BARRIERS. Robert Gremion (to Commissariat à l'Energie Atomique). British Patent 961,764. June 24, 1964. Priority date Nov. 29, 1961, France.

The method and equipment for determining the mean radius of pores in microporous barriers such as those utilized in processes for the isotopic separation of uranium hexafluoride are described. The method consists of determining the pressure differential across the barrier and the pressures prevailing on either side of the barrier. Equations are presented for determining the average radius of the pores from the measured values. (C.E.S.)

MATHEMATICS AND COMPUTERS

32011 (AE-145) A USER'S MANUAL FOR THE NRN SHIELD DESIGN METHOD. E. Aalto, R. Fraeki, L. Hjaerne, M. Leimdoerfer, K. Lindblom, S. Linde, K. Malen, and K. Nyman (Aktiebolaget Atomenergi, Stockholm). June 1964. 110p.

A code system for bulk shield design written for a Ferranti Mercury computer is described. The idea of an "almost direct" flux, as in the removal theory, serves as a basis for further development of the theory. An important aspiration has been to minimize the manual work of administering the codes. The codes concerned are: NECO, computing necessary group constants from primary data, REFUSE and REBOX (infinite plane or cylindrical, and box geometry, respectively), computing removal flux, NEDI a one-dimensional (plane, spherical, cylindrical) diffusion multigroup code, and SALOME a Monte Carlo code computing the gamma flux. Output tapes are constructed for direct use as input tapes, when required, for a following code. (auth)

32012 (AECL-1978) APEX-IV: AN ALGEBRAIC COMPILER FOR THE G-20 COMPUTER. J. M. Kennedy, E. A. Okazaki, and J. K. Fowler (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1964. 70p.

APEX is an ALGOL-like algebraic language for writing computer programs. This report describes APEX-IV, the version of APEX that has been in use on the A.E.C.L. G-20 Computer since January, 1964. The expanded language allows a number of declarations and operations that were not available in the original APEX. This report replaces the former APEX manuals, CRT-1148 (AECL-1728) and TPI-102, but does not impair the validity of their contents. (auth)

32013 (AEEW-R-300) A NOTE ON BINARY PSEUDO-RANDOM CODES. A. Hopkinson (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Aug. 1963. 8p.

Some mathematical aspects of binary pseudorandom codes are discussed and a theorem, which simplifies the derivation of their autocorrelation functions, is proved. (auth)

32014 (BNL-863) EIGENVALUE SPACING DISTRIBUTIONS FOR COMPARISON WITH EXPERIMENTAL DATA. A Series of Computer Programs. K. Fuchel, J. D. Garrison, and Lourdes R. Zavitsas (Brookhaven National Lab., Upton, N. Y.). May 1964. Contract [AT(30-2)-Gen-16]. 36p.

A series of computer programs are described, which utilize the output eigenvalues of the Random Matrix Diagonalization code [see BNL 760] to obtain eigenvalue spacing distributions and their moments. These distributions and moments were used for comparison with nuclear level spacing distributions obtained from neutron cross section measurements, and also for providing corrections for the nuclear level spacing distributions and moments for the weak levels that have been missed experimentally and for the extra levels which may be erroneously included. (auth)

32015 (CERN-64-30(p.279-85)) REMARKS ON ON-LINE COMPUTER USE. R. H. Miller (Chicago. Univ. Inst. for Computer Research).

A general discussion of on-line computer economics, accuracy, and uses is presented. (R.E.U.)

32016 (HMI-B-32) UBER EIN ALLGEMEINES ITERATIVES VERFAHREN ZUR LOSUNG DES DIRICHLETPROBLEMS FUR LINEARE ELLIPTISCHE DIFFERENTIALGLEICHUNGEN BELIEBIGER GERADER ORDNUNG. (On a General Iterative Method for Solution of Dirichlet Problems for Linear Elliptical Differential Equations of Optional Even Order). F. Stummel (Hahn-Meitner-Institut fur Kernforschung, Berlin). Apr. 1964. 11p.

The convergence of the Balayage method in Hilbert space was investigated. Some general operators, $T_j = \alpha_j P_j + (1 - \alpha_j)I$, $j = 1, 2, \ldots$, were calculated, beginning with a series of projection operators P_j, $j = 1,2 \ldots$. The convergence of the series of operators $R_n = T_{j_n} \ldots T_{j_1}$ with respect to a projection operator is shown. The first results were formulated in lemma 1. Simple results of this lemma are the weak convergence of the series $\{R_n\}$, the convergence of $\{R_n\}$ in a fixed norm, and the uniform convergence of the series $\{R_n\}$. The strong convergence of the series $\{R_n\}$ for special index series is shown. Lemma 2 permits assumptions to be derived on the strong convergence in a series of cases. Some examples to clarify the concepts and results of the study are presented. (tr-auth)

32017 (HW-81367) FOILS: A PROGRAM FOR COMPUTING NEUTRON EXPOSURES FROM FOIL-ACTIVATION DATA. W. C. Morgan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT(45-1)-1350. 20p.

The procedures used in obtaining integrated neutron exposures from foil activation data are presented and the IBM 7090 FORTRAN program that performs the calculations is discussed. (auth)

32018 (IS-851) 1401 MULTIPLE UTILITY PROGRAM WITH SIMULTANEOUS INPUT-OUTPUT PROCESSING. Karolyn Edwards and David E. McFarland (Ames Lab., Ames, Iowa). Mar. 1964. Contract W-7405-eng-82. 33p.

POGINOUT, a simultaneous input-output utility program for the IBM 1401 computer, is described. The procedure is given for writing any 1401 program with simultaneous input-output. The description and procedure can be used in writing similar utility programs for 1401's used as peripheral equipment to a larger computer. The report contains comments on procedures not used in POGINOUT but which might be appropriate under slightly different conditions. Familiarity with this program aids in optimum use of the POGO executive system. The normal user will find those sections pertaining to code words and carriage control the most useful. (auth)

32019 (LADC-6476) A REVIEW OF CHARACTERISTICS OF AVAILABLE SMALL COMPUTER SYSTEMS WITH REGARD TO THEIR ON-LINE APPLICATION. Jules S. Levin (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 6p. (CONF-593-1)

From the Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964.

A review is presented of requirements of components for use in a real-time system for the acquisition and reduction of nuclear data from the Los Alamos Tandem Accelerator Facility, which consists of an 8-Mev vertical electrostatic accelerator and a 15-Mev tandem Van de Graaff accelerator. Computers manufactured in the U. S. with a cost less than $150,000 for the basic binary computer with one IBM-compatible magnetic tape transport were considered. (R.E.U.)

32020 (MLM-1186) VARIATIONAL METHOD FOR LEAST SQUARES SOLUTIONS OF LINEAR AND NON-

LINEAR EQUATIONS. Kenneth C. Jordan (Mound Lab., Miamisburg, Ohio). Mar. 27, 1964. Contract AT(33-1)-Gen-53. 11p.

A variational method of applying the principle of least squares to curve fitting is presented to solve half life data involving more than one radioactive isotope. The method applies equally well to equations that have linear or non-linear constants. In both cases the variational method has advantages over standard methods, although the most probable values and probable errors are the same by both methods. (auth)

32021 (ANL-Trans-43) METHOD OF ELIMINATING THE APERIODIC PATTERN OF A FOURIER ANALYSIS, FOR EXAMPLE IN MEASUREMENTS WITH A PILE-OSCILLATOR. R. Persson (Aktiebolaget Atomenergi, Stockholm). Translated for Argonne National Lab., Ill., from report AEFI-54. Jan. 1957. 7p.

It is shown that aperiodic disturbances may be eliminated from Fourier analysis by unequal damping of the signal from the pile-oscillator detector. (R.E.U.)

32022 (ANL-Trans-47) SOME PROBLEMS OF STATISTICAL ANALYSIS ARISING FROM THE PHYSICS OF MICROCORPUSCLES. I. POISSON DISTRIBUTIONS AND RELATIVE MEASUREMENTS. H. Breny. Translated by Rita R. Inston (Argonne National Lab., Ill.), from Ann. Soc. Sci. Bruxelles. Ser. I, 71: 135-60(1957). 28p.

A detailed comparison of statistical methods applied to problems in microcorpuscular physics where the experimental data (e.g., particle counts, n_i, over time intervals given by T_i, $\Sigma T_i = 1$, $i = 1, \ldots N$) are mutually independent Poisson variates is given. The asymptotically equivalent methods of maximum likelihood, minimum χ^2, and modified minimum χ^2 are applied to the general problem of determining parameters θ_k (e.g., the half life) from the expected values of the n_i. When n_i is a linear or an exponential function of θ the efficiencies of the methods are compared with those of weighted and non-weighted least squares. The relative efficiency when the T_i are equal and when they compensate exactly for natural inequalities (e.g., of emissive powers) grows with N. When n_i is a hyperbolic function of θ the method of maximum likelihood reduces the number of unknowns by one, taking into account the relativity of the measurements, and compares satisfactorily with the iterative method sometimes used. (R.E.U.)

32023 A VISUAL DISPLAY OF SOME PROPERTIES OF THE DISTRIBUTION OF PRIMES. M. L. Stein, S. M. Ulam, and M. B. Wells (Los Alamos Scientific Lab., N. Mex.). Am. Math. Monthly, 71: 516-20(May 1964). (LADC-6147)

The lattice points in a plane are numbered by a single sequence proceeding counterclockwise in a spiral. The set P of those lattice points whose single index becomes a prime is considered. The points of P located on straight lines have indices which ultimately consist of values of a quadratic form. The set P appears to exhibit a strongly nonrandom appearance due to the fact that some lines corresponding to quadratic forms which are factorable are devoid of primes and other quadratic forms are rich in primes. Several numbering sequences were investigated. (C.E.S.)

32024 HARTREE-FOCK HAMILTONIANS AND SEPARABLE NONLOCAL POTENTIALS. Saul T. Epstein (Univ. of Wisconsin, Madison). J. Chem. Phys., 41: 1045-6 (Aug. 15, 1964).

It is pointed out that there are many Hamiltonians that have the Hartree-Fock wavefunction as an eigenfunction. These can be used to start perturbation calculations, different choices giving different results. The possible usefulness of separable, nonlocal potentials is outlined. (auth)

32025 ON AN INTEGRAL EQUATION OF POTENTIAL THEORY. Henrik L. Selberg. Kgl. Norske Videnskab. Selskabs, Forh., 36: 4-9(1963). (In German)

32026 INVARIANCE HYPOTHESIS AND HIGHER CORRELATIONS OF HAMILTONIAN MATRIX ELEMENTS. Nazakat Ullah (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 58: 65-71(Sept. 1964).

A method is developed for calculating the averages of the components of a randomly oriented unit vector in an N dimensional orthogonal, unitary, and symplectic space. The method is extended to calculate the averages of the components of two orthogonal N dimensional randomly oriented unit vectors. Using the invariance hypothesis it is shown that the off-diagonal matrix elements are distributed symmetrically about zero mean and that there are no correlations between an odd power of the off-diagonal matrix element and any power of diagonal or another off-diagonal matrix element. An expression is given for the correlation coefficient of the squares of diagonal matrix elements. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

32027 (A/CONF.28/P/233) OXIDE FUEL FABRICATION AND PERFORMANCE. S. Naymark (General Electric Co. [Atomic Power Equipment Dept.], San Jose, Calif.) and C. N. Spalaris. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Design considerations and fabrication techniques are surveyed for oxide fuels used in power water-cooled reactors. Performance of Zircaloy-2- and stainless-steel-clad fuel elements is reviewed. Fission gas release from fuel elements is considered. Possible future improvements in the fuel elements are discussed. (D.L.C.)

32028 (A/CONF.28/P/234) CARBIDE FUEL FABRICATION AND PERFORMANCE. Harry Pearlman Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.) and R. F. Dickerson. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The phase properties of the U–C system are outlined. The fabrication and irradiation performance of UC and UC–PuC fuel elements are described. (T.F.H.)

32029 (A/CONF.28/P/235) CERAMIC-COATED-PARTICLE NUCLEAR FUELS. R. W. Dayton (Battelle Memorial Inst., Columbus, Ohio), W. V. Goeddel, and W. O. Harms. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of the fabrication and performance of fuels consisting of coated uranium and thorium–uranium carbide or oxide particle dispersions in graphite or oxide matrices. The performance results indicate that pyrolytic carbon and alumina coatings retain fission gases, while alumina and beryllia coatings are nearly impermeable to all fission products. Two problems, the release of certain volatile fission products through pyrolytic carbon coatings and the deposition of strong beryllia coatings on urania particles, are being studied. (D.L.C.)

32030 (A/CONF.28/P/236) URANIUM–PLUTONIUM CERAMIC FUELS. E. A. Evans (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), W. E. Roake, F. J. Leitz, and A. Strasser. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The fabrication, evaluation, and post-failure behavior of U–Pu reactor fuel elements is summarized. The elements studied include mixed U–Pu oxides and carbides. (T.F.H.)

32031 (A/CONF.28/P/253) CONTROL ROD MATERIALS. Abe N. Holden (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.), Bernhardt Weidenbaum, and Carl F. Leitten, Jr. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented on the fabrication, physical properties, radiation effects and performance of boron materials, Hf, Ag–In–Cd, and lanthanons, for use as control rod materials. Materials used for control rods in U. S. power reactors are listed, and data on boron compounds are tabulated. The economics of control rod materials is briefly discussed. (P.C.H.)

32032 (A/CONF.28/P/254) DEVELOPMENTS IN SOLID MODERATOR MATERIALS. R. E. Nightingale (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), C. G. Collins, and J. A. McGurty. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of technological advances in the U. S. A. on carbons and graphite, beryllium oxide, and metallic hydrides. Included are properties, manufacture, and stability in reactor environment. (R.E.U.)

32033 (A/CONF.28/P/255) CLADDING MATERIALS FOR NUCLEAR FUELS. Warren P. Chernock (Combustion Engineering, Inc., Windsor, Conn.), Ross M. Mayfield, and James R. Weir, Jr. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The uses of stainless steels and zirconium base alloys, nickel and vanadium alloys, refractory metal alloys, and Be in power reactor systems are discussed within the framework of selected topics on mechanical and physical properties, radiation damage, fabrication development, and performance. 130 references are included. (P.C.H.)

32034 (BM-RI-6304) PREPARATION AND EVALUATION OF FUSED HAFNIUM CARBIDE. Robert P. Adams and R. A. Beall (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Feb. 1963. 19p.

A method was developed to melt and cast specimens of hafnium–carbon alloy, and their properties were studied. A rotating-ladle vacuum or inert atmosphere arc furnace was designed, special electrodes and molds were developed, and operating procedures were worked out for casting small shapes. The cast specimens were evaluated according to their carbon content for melting point, density, microhardness, electrical resistivity, and oxidation resistance. Lattice dimensions were determined, and metallographic specimens were prepared. Photomicrographs were taken of specimens containing 2.72, 5.50, 6.47, 9.97, 12.8, and 15.7 weight-percent carbon, and their grain structures were compared. (auth)

32035 (BMI-X-10073) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report, October–December 1963. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 24p. (EURAEC-957)

Fabrication studies revealed that the grain size of cast UN can be significantly decreased by decreasing the cooling profile during the solidification process. Alloy additions of both ZrN and TiN were made in UN by the consumable-electrode melting process. A eutectic composition was found in the UN-TiN system at dilute alloy additions. The electrode melting was more uniform and the casting sounder in this system. The decomposition studies of UN were extended to nitrogen pressures of 25 to 100 atm. A UN-nitrogen reaction forming liquid effectively lowers the melting point of UN at high nitrogen pressures. The vapor pressure of uranium over UN was measured by Knudsen effusion-cell techniques, and an equation was developed. The irradiation of 20 specimens of UN is under way. Corrosion of hypostoichiometric,

stoichiometric, and hyperstoichiometric UN was studied in water, NaK, Santowax R, and air. No attack was noted in NaK at 800°C. The compatibility of UN with aluminum, stainless steel, and Zircaloy-2 was studied to times of 1600 hr. (auth)

32036 (BMI-X-10091) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. Quarterly Progress Report, Arpil–June 1964. Robert D. Koester, John A. DeMastry, Warren E. Berry, Arthur A. Bauer, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). July 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 6p. (EURAEC-1139)

Alloys containing 18 to 24 at.% titanium, 12 to 18 at.% vanadium, and 9 to 12 at.% chromium alloy rather outstanding corrosion resistance to 540°C steam. A niobium-21 at.% titanium-12 at.% vanadium-9 at.% chromium alloy exhibits a weight gain of only 396 mg/dm^2 after 357 days of exposure. Corrosion is characterized by the formation of a shiny black adherent oxide film. The niobium-21 at.% titanium-12 at.% vanadium-9 at.% chromium alloy after 912 hr in 565°C steam in the ACS-1 facility shows a weight gain of 157 mg/dm^2. Other specimens from this ingot exposed to 540, 650, and 750°C 1500-psi steam have accumulated 28 days with weight gains of 85, 454, and 1053 mg/dm^2, respectively. The three sets of specimens exhibit an iridescent-tarnish film, a blue-gray film, and a dark-gray film, respectively. Tensile properties of the niobium-21 at.% titanium-12 at.% vanadium-9 at.% chromium alloy were determined at 540, 675, and 815°C. A stress of 135,000 psi, which is approximately 90% of the 0.2% offset yield strength, is being used as the stress level for stress-corrosion tests. (auth)

32037 (BMI-X-10092) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report, April–June 1964. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). July 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 24p. (EURAEC-1136)

Hot-hardness, thermal-conductivity, and electric-resistivity data were obtained on cast UN for comparison with the previous measurements made on material fabricated by powder techniques. The data confirmed the earlier measurements. Additional tests were completed to determine the chemical compatibility of UN with stainless steel, Zircaloy-2, nickel, chromium, zirconium, and iron. The effects on UN of irradiations to peak burnups, exceeding 3.5 at.% of the uranium at surface temperatures to 550°C were determined. Irradiation of 20 additional UN specimens to burnups of about 5 at.% of the uranium at surface temperatures of 500 to 700°C were terminated. (auth)

32038 (DC-60-2-285) STRESS ANALYSIS OF METALLIC FUEL ELEMENTS—STRUCTURAL MEMO NO. 41. D. R. Riley and B. R. Thompson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 16, 1960. Contract AT(11-1)-171. 43p.

Stresses and deflections, resulting from a nuclear operation design point, are presented in tabular and graphical form for the highest stressed fueled cylinder of each of the following configurations: 102, 103A-9 Ring, 103A-15 Ring, 103B-Reference Shell, and 103B-Internal Support (2 Supports). Results are given over the full length and around the full circumference of the cylinders. (auth)

32039 (EURAEC-974) IMPERFECTIONS IN METALS. II. CORROSION AND OXIDATION. Quarterly Report No. 5, October 1–December 31, 1963. (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 082-62-7-RDB. 25p. (R-2271)

During electron microscopic observation of niobium foils, the presence of fringe patterns dividing the individual grains into a domain-like structure was noticed. The phenomenon was found in foils of different purity after an annealing treatment of two hours at 1500°C in a vacuum of $\pm 10^{-5}$ mm Hg. It is most probable that gaseous contamination is responsible for the phenomenon. The fringe pattern was asymmetrical in the bright field image and symmetrical under dark field illumination. The aspect and the properties of the fringe patterns were exactly the same as those observed for antiferromagnetic domain boundaries in nickel oxide and ferroelectric domain boundaries in barium titanate. The fringe patterns move under normal electron irradiation during observation. The movement was rather gradual although sometimes discontinuous movement was also observed. Selected area diffraction patterns taken over these boundaries show the presence of supplementary spots which can be indexed as a superlattice of the matrix. It is assumed that the fringe systems are domain boundaries, the domains being regions where specific interstitial sites are occupied by oxygen. The presence of the interstitials is then responsible for the deformation of the body-centered cubic lattice leading to a fringe pattern image in the boundaries. The motion of the boundaries arises then from jumping of the interstitials from one site into the other, changing in this way the distribution of the interstitials. The presence of superlattice dislocatic is supports the interpretation of ordering. A second hypothesis, i.e., of antiferromagnetism in columbium, is rejected on the basis of electron diffraction considerations. (auth)

32040 (HW-68600-39) PLUTONIUM ABSTRACTS. Volume 4, Number 5. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1964. Contract AT(45-1)-1350. 30p.

A total of 25 abstracts is presented on new developments in plutonium technology. The abstracts are arranged into the following subject fields: biology and medicine, chemistry, metallurgy and ceramics, physics, reactor technology, and miscellaneous. (D.L.C.)

32041 (HW-81269) METALLURGY RESEARCH OPERATION. Quarterly Progress Report, January–March 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1964. Contract AT(45-1)-1350. 151p.

The four sections of this report are abstracted separately. (N.W.R.)

For abstracts of individual sections see: 32042, 32043, 32044, and 32139.

32042 (HW-81269(p.3.1-38)) PHYSICAL METALLURGY. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effects of radiation on molybdenum crystals are studied. The effects of quenching and aging on the yield stress of polycrystalline nickel are analyzed. Particle size distribution in uranium alloys with small additions of iron and silicon is studied with respect to heat treatments. Swelling in irradiated uranium–zirconium alloys is evaluated. The creep of beta, delta, and gamma plutonium is analyzed with respect to activation energies for the steady state.

The crystal structure, phase studies, metallography, and mechanical properties of plutonium are investigated. (N.W.R.)

32043 (HW-81269(p.4.1-64)) REACTOR METALS RESEARCH. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effects of radiation on the physical properties and oxidation behavior of reactor materials are summarized. Properties are discussed for type 304 stainless steel, Hastelloy R-235, Hastelloy C, Hastelloy N, Hastelloy X-280, Haynes 25 Alloy, Inconel 600, Inconel 625, Inconel 702, Inconel 718, Inconel X-750, Incoloy 800, molybdenum, niobium–zirconium alloy, R-27, Zircaloy-2, rhenium–tungsten alloy TZM, Cb-752, iron, and tantalum–tungsten alloy. The effects of radiation on dislocations in crystals are analyzed by studying the plastic deformation of iron crystals. The operation of the G-7 hot water loop in ETR is discussed. (N.W.R.)

32044 (HW-81269(p.6.1-7)) MATERIALS ENGINEERING. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The development of the gas loop Mark I test section is discussed. In-reactor monitoring, transverse properties, and materials testing of irradiated PRTR Zircaloy-2 pressure tubes are evaluated. (N.W.R.)

32045 (HW-SA-3579) PRECIPITATE PARTICLES IN DILUTELY ALLOYED URANIUM—QUANTITATIVE METALLOGRAPHY. K. N. Woods, R. D. Leggett, and Y. E. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 11, 1964. Contract [AT(45-1)-1350]. 50p. (CONF-607-1)

From AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964.

A quantitative metallographic evaluation was conducted on the precipitation of dispersed second phase particles in a dilute uranium alloy containing 180 ppm Fe and 90 ppm Si. Specimens from five different combinations of alloy content and heat treatment were subjected to a syntron polish and a cyclic electropolish-electroetch, which combined to yield a surface on which the dispersed phase was in relief. Particle interface diameters were measured with the Zeiss Particle Size Analyzer on electron micrographs of UO_2 shadowed carbon replicas. Various mathematical techniques were applied to the particle interface data to yield quantitative information on the volume fraction and three dimensional particle size distribution of the dispersed phase. (auth)

32046 (IS-872) RARE EARTH INTERMETALLIC COMPOUNDS. O. D. McMasters and K. A. Gschneidner, Jr. (Ames Lab., Ames, Iowa). July 2, 1964. Contract W-7405-eng-82. 110p. (CONF-506-2)

From Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964.

Some of the important properties of the rare earth intermetallic and semimetallic compounds are reviewed. The alloy chemistry of these compounds is examined and discussed, especially from the point of view of phase stability and formation. In some instances europium behaves as a divalent ion. This presents an interesting reactor problem because europium, through neutron capture, eventually decays to gadolinium which is trivalent. This problem is also discussed. A compilation of the crystal structures of these compounds is appended to this review. (auth)

32047 (IS-799) HIGH-VACUUM LIQUID METAL DISTILLATION: AN ANNOTATED BIBLIOGRAPHY. D. E. Westerheide and George Burnet (Ames Lab., Ames, Iowa). May 1964. Contract W-7405-eng-82. 29p.

This annotated bibliography consists of two sections: the first a chronological survey in which each reference is identified by investigator(s) and the work reported briefly summarized, and the second a conventional bibliography arranged in alphabetical order by investigator. References selected deal with the theory and practice of high vacuum liquid metal distillation and cover the period from 1912 through 1963. All pertinent publications appearing in Chemical Abstracts and Nuclear Science Abstracts were included as were several unpublished theses. (auth)

32048 (NLCO-909) GRAIN SIZE STANDARDS FOR BETA-HEAT-TREATED URANIUM FUEL CORES. M. H. Cornett (National Lead Co. of Ohio, Cincinnati). May 14, 1964. Contract AT(30-1)-1156. 6p. (CONF-607-3)

From AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964.

Visual standards are presented for rating grain size at 3X of the following beta heat-treated uranium fuel cores: (1) oil-quenched, extruded tubular fuel cores, (2) oil-quenched, rolled I & E fuel cores, and (3) water-quenched, rolled I & E fuel cores. (auth)

32049 (NLCO-911) MODIFICATION OF AN ATTACK-POLISH PROCEDURE. M. H. Cornett and E. L. Schaich (National Lead Co. of Ohio, Cincinnati). May 14, 1964. Contract AT(30-1)-1156. 4p. (CONF-607-5)

From AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964.

A description is given of the modification of an attack-polish procedure which reduces sample preparation time and provides a scratch-free surface on uranium metal. (auth)

32050 (NLCO-913) VACUUM ARC MELTING OF PRODUCTION-SIZED URANIUM INGOTS. Herbert Davis and Robert L. Schardt (National Lead Co. of Ohio, Cincinnati). June 8, 1964. Contract AT(30-1)-1156. 15p. (CONF-603-1)

From Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June-July 1964.

Consumable-electrode arc melting was used to produce 42 production-sized uranium ingots. Procedures for the arc melting of uranium in a vacuum were established and the effects of the process on metal quality levels were determined. (auth)

32051 (NLCO-915) ELECTRON MICROPROBE STUDIES OF DILUTE URANIUM-BASE ALLOYS. J. W. Colby and W. N. Wise (National Lead Co. of Ohio, Cincinnati). June 4, 1964. Contract AT(30-1)-1156. 17p. (CONF-607-2)

From AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964.

Described are some preliminary studies of uranium employing a recently acquired Applied Research Laboratories EMX microprobe analyzer. In particular, the results of studies on solid metal and shot containing phosphorus additions and on uranium shot containing zirconium additions are described. Results from a study of cladding failures of some Mark V-E fuel cores (Savannah River) are also discussed. (auth)

32052 (NP-14109) IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE. Quarterly Progress Report, May 1–July 31, 1963. (National Carbon Co. Research Lab., Parma, Ohio and National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). Aug. 15, 1963. Contract AF33(657)-11171. 78p.

Results are reported primarily from studies on the pyrolysis mechanism of pure aromatic hydrocarbons but include some work on commercial materials, such as tars and pitches. Differential thermal analyses (DTA) on three gilsonite pitches have indicated that gas evolution and increasing viscosity, rather than exothermic reactions, are responsible for foaming observed during coking studies. The increase in coking value effected by the NH_2, =O, and NO_2 substituents on aromatic rings is demonstrated. Stable radical intermediates have been found to occur during the decomposition of a number of diazo compounds. Two methods of producing coke with high isotropic thermal expansion characteristics (in the range of most refractory carbides) are discussed. Graphite bulk densities of 1.868 g/cc made from coke produced at the pilot-scale experimental coker at Robinson, Illinois are reported. Relative oxidation of JTA, ATJ, and SiC-coated graphite at 1600°C is presented. Results of field evaluations of promising materials are given. (auth)

32053 (NP-14144) APPLICATION OF THIN-FILM ELECTRON MICROSCOPY TO REFRACTORY METAL PROCESSING. Quarterly Progress Report, March 11–June 11, 1964. R. P. Jewett (Rocketdyne. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 11, 1964. Contract NOw64-0299-d. 18p. (R-5776-1)

Results for a program to correlate substructural effects of refractory metal processing by transmission electron microscopy are presented. The results of deforming commercially pure tantalum by cold rolling are comparable to the results obtained with tantalum deformed in tension. Preliminary results of cold rolling tantalum show that dislocation arrays do not increase proportionally with the degree of cold work. On the other hand, cell structure becomes more fully defined with increasing deformation. As in tension, it was found t the grain boundaries can act either as sinks or sources for dislocation, depending upon the amount of deformation. (auth)

32054 (ORNL-P-84) ELECTRON METALLOGRAPHY OF PYROLYTIC CARBON COATINGS ON FUEL PARTICLES. C. K. H. DuBose and J. O. Stiegler (Oak Ridge National Lab., Tenn.). [1962]. Contract [W-7405-eng-26]. 17p. (CONF-607-4)

From the AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964.

A replica electron microscope study of as-polished and cathodically etched surfaces of pyrolytic carbon coatings on fuel particles has been made in an attempt to characterize coatings that showed as much as 30% difference in bulk density. High and low density coatings could be characterized by their polished surface textures; however, these features were not indicative of the true structure as seen by direct electron transmission. Microvoids detected by the transmission study of cleavage flakes exist on too fine a scale to be observed either optically or by electron microscope examination of replicas of the polished surfaces. Other features such as the effect of cathodic and chemical etching, coating delamination, and duplex coating interfaces have also been examined. (auth)

32055 (ORNL-TM-859) TECHNICAL STATUS OF THE ORNL THORIUM UTILIZATION PROGRAM. D. E. Ferguson and J. A. Lane (Oak Ridge National Lab., Tenn.). May 6, 1964. Contract W-7405-eng-26. 26p. (CONF-570-1)

From AEC Symposium on Advanced Converter Reactor Prototypes, Washington, D. C., Mar. 1964.

A review is presented of the status of thorium fuel cycle technology. This includes head-end processes for thorium fuels, the acid Thorex process, the sol-gel process for preparing reactor fuel materials, the Kilorod program, irradiation testing of sol-gel fuels, preparation of microspheres by sol-gel, and a description of the Thorium–Uranium Fuel Cycle Development Facility. (auth)

32056 (TID-19355) ELECTROWINNING CERIUM METAL FROM CERIUM DIOXIDE. J. A. Porter (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Aug. 1963]. Contract AT(07-2)-1. 16p.

Cerium metal was produced in fully coalesced form by electrolysis in a fused fluoride salt system with cerium dioxide feed. The high yield process employs a new technique of feed assimilation to avoid oxide contamination of the metal product. (auth)

32057 (TID-20777) A FUNDAMENTAL STUDY OF THE CORROSION OF METALS IN ACIDS AT THE BOILING POINT. SIX STUDIES RELATING TO THE FORMATION AND PROPERTIES OF INTERMETALLIC COMPOUNDS. Final Report. (Virginia Inst. for Scientific Research, Richmond). May 15, 1964. Contract AT(40-1)-2502. 82p.

Seven sections are presented which summarize some of the major discoveries made in studies of intermetallic compounds relative to boiling acid corrosion. Separate abstracts were prepared for all seven sections. (D.L.C.)

For abstracts of individual chapters see: 32058, 32059, 32068, 32087, 32088, 32089, and 32168.

32058 (TID-20777(p.33-59)) ELECTROCHEMICAL SYNTHESIS OF III-V COMPOUNDS. Melvin C. Hobson and Henry Leidheiser, Jr. (Virginia Inst. for Scientific Research, Richmond).

Experiments were made on the electrochemical preparation of the antimonides and arsenides of Ga and In, and In bismuthide. It was found to be necessary to apply a potential under conditions where the cation will plate out on the cathode before the intermetallic will form. Only 1 : 1 compounds were formed, and they had large grain growth and little mechanical strength. Kinetic studies on In antimonide showed the mechanism of formation to be more complicated than simple thermal diffusion. (D.L.C.)

32059 (TID-20777(p.60-70)) INTERMETALLIC COMPOUND FORMATION IN THE COPPER–TIN SYSTEM. Melvin C. Hobson and Henry Leidheiser, Jr. (Virginia Inst. for Scientific Research, Richmond).

Copper single crystals were coupled to tin in boiling solutions of 2M HCl containing 10^{-2} M Sn(II). The (111) plane was first to be coated, followed by the (100) plane. The bulk of the surface film is Cu_6Sn_5 and a small steady-state concentration of β-Sn. A mechanism for the formation of the surface film is proposed in which β-Sn first forms by nucleation at dislocation sites, followed by the formation of Cu_6Sn_5. Cu_6Sn_5 is formed in preference to Cu_3Sn because of its lower activation energy of formation, but on uncoupling and heating of the electrode, Cu_6Sn_5 is converted into Cu_3Sn. (D.L.C.)

32060 (TID-20826) TOPOLOGICAL STUDY OF THE SINTERING PROCESS. Annual Progress Report. (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Feb. 1964. Contract AT(40-1)-2581. 97p.

In the quantitative characterization of microstructure, the linear relationship between surface area and density is demonstrated to be valid in a widening range of geometric variations, including: initial number of contacts per par-

ticle, amount of precompaction, material being sintered, sintering temperature, particle size, and to some extent, particle shape. It is shown that this relationship implies constancy of the mean chord intercept of porosity throughout most of densification. The implications of this result are investigated. The total length of channel in sintered structures is estimated with a new technique, providing additional structural information. The application of algebraic topology to measurements made on a series of closely spaced microsections is used to demonstrate the feasibility of complete characterization of the topological properties of even the most complex structure. The topological model is extended to the domain of multiphase sintering, with immediate success. It is demonstrated that stresses comparable to those measured in the sintering force experiments produce measurable creep rates in bulk copper at sintering temperatures. Measurements of mechanical properties as a function of controlled structural variations have shown that the hardness, fracture strength, and elongation, while very sensitive to the sintered density of the material, are unaffected by variations in the initial particle size. (auth)

32061 (UCRL-11317(p.198-203)) REACTOR MATERIALS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The solubility of helium in uranium dioxide is studied. The effects of alpha particles on semiconductors and silicon junctions are discussed. An analysis is made of fission gas release from irradiated fuel elements and experimental data are given for the analysis. (N.W.R.)

32062 (Y-DA-196) INTERIM REPORT ON THE APPLICATION OF ZONE REFINING TO THE PURIFICATION OF BERYLLIUM METAL. J. H. Keith (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Sept. 4, 1962. Contract W-7405-eng-26. 43p.

Apparatus and techniques for the zone purification of beryllium have been developed, and analytical data on zone-refined beryllium obtained. Results indicate significant purification of beryllium by this process. (auth)

32063 (EURAEC-1060) QUARTERLY REPORT NO. 7 [ON CORROSION OF STEEL], JANUARY 1–MARCH 31, 1964. G. Chaudron (France. Centre National de la Recherche Scientifique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7 RDF. 17p. (A translation).

It is shown by coulometry that stainless steels of high-grade quality have the same properties of passivation as standard industrial 18/10 steels. However, it seems that the martensitic high-grade 18/8 steel can be passivated more rapidly than austenitic commercial steel and that the maximum thickness of the passivation-shell is thinner. The effects of axial tension tests within a boiling solution of magnesium chloride on the life of austenitic high-grade and commercial 18/10 stainless steels is evaluated. Corrosion is not seen under stress in respect to high-grade 18/10 steel submitted to mechanical stress lower than the force of the yield strength. There is no corrosion in the high-grade 18/10 steel under stress in the two-phase state. The magnetic phase present in pure steel after various heat treatments is surveyed. The influence of the tempering treatments on the stability of the martensitic phase is analyzed by measuring magnetic moments. (N.W.R.)

32064 (EURAEC-1064) STUDY OF THE SHAPING AND THE IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Progress Report No. 13, January 1–March 31, 1964. J. P. Dumas and B. Mansard (France. Commissariat à l'Energie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 080-62-3-RDF. 24p. (A translation).

Irradiation of uranium carbide fuel elements in Melusine and EL-3 is continuing. The analogical thermal treatment of the fuel elements for studying swelling is started. The first out-of-pile tests of the safety device with which the irradiation seal for EL-3 will be equipped are satisfactory. Compatibility tests between stainless steel and zirconium carbide clearly show that it will be possible to use these materials in the actual irradiation conditions. Methods for measuring thermal conductivity before and after irradiation are improved. (N.W.R.)

32065 (EURAEC-1066) DEVELOPMENT OF PROCESSES FOR FABRICATION OF URANIUM CARBIDES AND CERMETS ON UC BASIS. Quarterly Report No. 15, January 1–March 31, 1964. P. Himmelstein, H. Kroll, B. Liebmann, and L. Schaefer (Nuklear-Chemic und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 088-62-7 RDD. 21p. (A translation)

The copper crucible of the tip casting furnace was improved to supply enough current for uranium carbide melting. Uranium carbide rods were melted and cast in the centrifugal casting furnace. Chemical analyses and microsections were made of all UC rods, the densities were ascertained and corrosion tests were performed. With the aid of an ultrasonic drilling machine, samples were prepared for thermal conductivity, dilatometer, elevated temperature hardness, and xenon diffusion measurements. The thermal conductivity results for stoichiometric UC samples were between 0.04 and >0.06 cal/cm sec °C. Impact tests on UC rods were continued. (auth)

32066 (JPRS-25069) PROCESSING HIGH-TEMPERATURE MAGNESIUM ALLOYS. M. E. (Ye.) Drits. Translation of Chapter Two and Bibliography of "Magnievye Splavy Dlya Raboty Pri Provyshennykh Temperaturakh," Moscow, 1964. 54p. (OTS-64-31474)

Translations are presented of the chapter on alloys on the base of the Mg–Th–Mn system, and of the bibliography from the Russian book "Magnesium Alloys for Operation at Elevated Temperatures." Separate abstracts were prepared for both the chapter and bibliography. (D.L.C.)

For abstracts of individual chapters see: 32067 and 32156.

32067 (JPRS-25069(p.32-53)) BIBLIOGRAPHIC REFERENCES. Translation of p.224-9 from "Magnievye Splavy Dlya Raboty Pri Provyshennykh Temperaturakh," Moscow, 1964.

A total of 258 references is presented on high-temperature magnesium alloys. (D.L.C.)

32068 AN ELECTROCHEMICAL METHOD FOR THE PREPARATION OF AuSn AND ITS POSSIBLE APPLICATION TO OTHER INTERMETALLIC COMPOUNDS. T. Granville Carver and Henry Leidheiser, Jr. J. Electrochem. Soc., 109: 68(1962). (TID-20777(p.5-7))

When Au electrodes are polarized in boiling 2M HCl containing 0.001M Sn(II) to potentials 10 to 100 mv more noble than Sn in the same medium, a uniform AuSn deposit forms very rapidly on the Au. The formation of other compounds, possibly $AuSn_2$ or $AuSn_4$, under other conditions is discussed. The formation of $PdSn_4$ on Pd in the same medium is also discussed. (D.L.C.)

32069 ELECTROLYTICAL DECONTAMINATION OF CONTAMINATED METALLIC SURFACES. G. Siewert and G. Trimborn. Kernenergie, 7: 335-9(May 1964). (In German)

Electro-polishing techniques were employed for the decontamination of radioactively contaminated metal surfaces. The polishing cells described enable the decontamination of the metal articles from hot cells and other enclosed installations. The equipment and technique described are covered by Industrial Patent (Wirtschaftspatent) No. 24843 [Germany]; French Patent No. 1,293,540; Polish Patent No. 46,355; and Czechoslovakian Patent No. 108,131. (OTS)

32070 NONEXTREMAL ORBITS IN MAGNETOACOUSTIC GEOMETRIC RESONANCES. S. G. Eckstein (Argonne National Lab., Ill.). Phys. Rev. Letters, 12: 360-2(Mar. 30, 1964).

It is pointed out that nonextremal Fermi-surface orbits may be observed in magnetoacoustic geometric resonances and that the conditions for observation of these orbits are much easier to attain in the case of geometric resonance than in the quantum oscillation case. The periods of oscillation for geometric resonances are calculated for a general ellipsoidal energy surface for an arbitrary angle between magnetic field and direction of propagation of sound. The geometric resonance effect for fields parallel to the sound waves is also investigated. (C.E.S.)

32071 TECHNETIUM. V. I. Spitsyn and A. F. Kuzmin (Inst. of Physical Chemistry, Moscow). Priroda, No. 3, 59-63(1964). (In Russian)

Preparations, applications, and properties of Tc and some Tc compounds are described. Isomeric transitions and half life of the technetium isotopes are also reviewed. (R.V.J.)

32072 REACTOR MATERIALS. Volume 7, Number 2. R. W. Dayton, E. M. Simons, and R. W. Endebrock (Battelle Memorial Inst., Columbus, Ohio). Summer 1964. $0.70(GPO) (domestic), $0.90(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 68p.

Properties, behavior, and fabrication processes of materials applicable to nuclear reactor components and associated equipment are reviewed. Separate abstracts are prepared for three of the five sections; the other two sections are included in this abstract (nuclear poisons and cladding and structural materials). Information is included on the dispersion poison materials, metallic poisons, refractory materials, ceramic materials, metals, alloys, cladding materials, structural materials, and fuel materials. (104 references). (N.W.R.)

For abstracts of individual sections see: 32073, 32074, and 32119.

32073 FUEL AND FERTILE MATERIALS. Reactor Mater., 7: No. 2, 81-105(Summer 1964).

Research and development progress on uranium, uranium alloys, uranium dioxide, uranium carbides, uranium nitrides, uranium systems, plutonium, plutonium dioxide, plutonium alloys, plutonium systems, thorium, thorium alloys, plutonium carbides, plutonium nitrides, dispersion fuels, cermet fuels, coated-particle fuel materials, refractory fuels, coatings, radiation effects on fuel materials, corrosion mechanisms, and fertile materials is reviewed. (98 references). (N.W.R.)

32074 MODERATOR MATERIALS. Reactor Mater., 7: No. 2, 106-17(Summer 1964)

Research on graphite, beryllium metals and alloys, beryllium oxides, and strontium hydrides for use as reactor moderators is reviewed. (50 references). (N.W.R.)

32075 CERAMIC CRUCIBLES FOR ELECTRON BOMBARDMENT HEATING. J. W. Voigt and K. W. Foster (Monsanto Research Corp., Miamisburg, Ohio). Rev. Sci. Instr., 35: 1087(Aug. 1964). (TID-20524)

A system is described by which excellent Be vapor deposits on thin plastic films were obtained. The Be was melted in a BeO crucible, and a potential of 1000 v was applied to an anode in the crucible. The Be formed a ball on the end of the anode which was maintained at 200 to 300°C above the crucible temperature. The entire system operated in a vacuum of 10^{-4} torr or less. (D.C.W.)

32076 BIBLIOGRAPHY ON REFRACTORY METALS AND ALLOYS (1961–1963). Henry H. Hausner and Helen C. Friedemann. Reutte/Tyrol, Austria, Metallwerk Plansee Aktiengesellschaft, 1964. 196p. $3.00.

References (916) on W, Mo, Ta, Nb, and Re and their alloys are given to U. S. and foreign journals and reports published from 1961 through 1963. The references are listed alphabetically according to names of authors, and a comprehensive subject index is included. (P.C.H.)

32077 LEAD 62. EDITED PROCEEDINGS [OF THE] FIRST INTERNATIONAL CONFERENCE ON LEAD. London, Lead Development Association, 1962. 259p. 45s.

The use of lead for cable sheathing, batteries, radiation shielding, and the chemical industry are discussed. Of the 23 papers presented, abstracts were prepared for the 4 papers on radiation shielding. (C.E.S.)

For abstracts of individual papers see: 31742, 32952, 32953, and 32954.

32078 POVERKHNOSTNYE YAVLENIYA VRASPLAVAKH I PROTSESSAKH POROSHKOVOI METALLURGII. (Surface Phenomena in Melts and in Processes of Powder Metallurgy). V. N. Eremenko, ed. Kiev, Publishing House of the Academy of Sciences, 1963. 460p. (IBM-3)

Fifty-three papers are included, surveying the theory of surface phenomena of metals, alloys, and other materials, and methods of investigating surface energies of metal, silicate, and salt melts on the melt-gas boundary and on the metal-slag and metal-salt interphase boundaries. Questions of surface energy in hard bodies, e.g., the effect of surface activated media on hard body destruction, are considered. The role of surface phenomena in ferrous and nonferrous metallurgy, powder metallurgy, and semiconductor systems is discussed. Processes of coating, roasting, and wetting of high-temperature metals are investigated. The book is intended for scientific workers, metallurgists, and engineers interested in surface phenomena at high temperatures and their practical applications. (M.J.T.)

32079 TUGOPLAVKIE SOEDINENIYA SPRAVOCHNIK PO SVOISTVAM I PRIMENENIYU. (Refractory Combinations: Reference Book on Properties and Application). G. V. Samsonov. Moscow, State Scientific and Technical Printing House, Literature on Ferrous and Nonferrous Metallurgy, 1963. 398p. (IBM-5)

The scientific classification of refractory combinations is given, and information is organized on chemical-crystal, thermal, thermochemical, electric, magnetic, optical, mechanical, chemical, and refractory properties of borides, carbides, nitrides, silicides, phosphides, and sulfides of metals, nitrides, carbides, and phosphides of boron and silicon, and alloys of boron and silicon. Data are included

on basic areas of the use of refractory combinations in metallurgical, chemical, and machine-construction industries, energetics, automation, and radio- and electrotechnology. A compendium of up-to-date graphs of conditions of systems, in which refractory combinations are formed, is presented. A bibliography of 1108 references is included. The handbook is intended for scientific and industrial workers, technologists, and designers, and is of interest to workers in planning organizations and to postgraduate students. (tr-auth)

32080 METALS REFERENCE BOOK. VOLUMES I AND II. THIRD EDITION. Colin J. Smithells. Washington, D. C., Butterworths, 1962. 1148p. $32.50.

Data on metallurgy and metal physics are summarized in tables and diagrams. The values given are those that contributors selected as the most reliable after a review of the published data. Topics covered include: introductory tables, general physical and chemical constants, line spectra of the elements, x-ray crystallography, crystallography, crystal chemistry, geochemistry, metallography, equilibrium diagrams, gas-metal systems, diffusion in metals, elastic properties and damping capacity, thermochemical data, physical properties of molten salts, general physical properties, thermoelectric properties and temperature measurement, radiating properties of metals, thermionic emission, photoelectric and secondary emission, electrical properties, steels and alloys with special magnetic properties, mechanical testing, mechanical properties of metals and alloys, hard metals, deep drawing properties, lubricants, friction, casting alloys and foundry data, refractory materials, fuels, carbon and graphite electrodes, controlled atmospheres for heat treatment, corrosion resistance of metals, electroplating and metal finishing, welding, solders and brazing alloys, and miscellaneous data. A bibliography is included at the end of each chapter. An index is also included. (M.C.G.)

Corrosion

32081 (A/CONF.28/P/243) CORROSION IN AQUEOUS SYSTEMS. J. E. Draley (Argonne National Lab., Ill.), J. A. Ayres, W. E. Berry, E. Hillner, and S. P. Rideout. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The corrosion of reactor materials is reviewed. An evaluation of in-reactor corrosion behavior is followed by consideration of the corrosion of materials by type, and efforts to develop new alloys. Major attention is focussed on the pressurized water reactor, the boiling water reactor, and the steam superheat reactor. The primary emphasis is on corrosion problems which relate to the economic production of nuclear power. (N.W.R.)

32082 (A/CONF.28/244) CORROSION IN LIQUID METAL SYSTEMS. D. H. Gurinsky (Brookhaven National Lab., Upton, N. Y.), J. R. Weeks, C. J. Klamut, L. Rosenblum, and J. H. DeVan. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Current theories of liquid-metal corrosion methods employed in liquid-metal testing and analysis, and the state-of-the-art of Na, K, Rb, Cs, Hg, and liquid alloys containing Pu are reviewed. Various stainless steels are considered. 118 references. (R.E.U.)

32083 (APEX-674) STRESS-CORROSION PROPERTIES OF 19-9DL ALLOY IN LITHIUM HYDRIDE. W. L. McCullough (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 26, 1961. Contracts AT(11-1)-171 and AF33(600)-38062. 17p.

The stress-to-rupture properties of 19-9 DL alloy were determined in contact with lithium hydride at 1175, 1325, and 1425°F (lithium hydride melts at 1267°F) at several stress levels. The test data indicate the stress-rupture properties are not noticeably affected even though surface attack was apparent on specimens exposed at 1325 and 1425°F for long periods of time. Metallographic examination showed the surface attack to be mainly a time-temperature function and not influenced to any great degree by the stress level. It was concluded that the usefulness of the 19-9 DL alloy as a structural material was not impaired by contact with lithium hydride at 1425°F for periods up to 100 hours. (auth)

32084 (GEAP-4313) SODIUM MASS TRANSFER. VIII. CORROSION OF STAINLESS STEEL IN ISOTHERMAL REGIONS OF A FLOWING SODIUM SYSTEM. J. D. Mottley (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Feb. 1964. Contract (AT(04-3)-189). 40p.

An analytical investigation was made on the mechanism of the isothermal "downstream" effect in the corrosion of stainless steel in sodium. A mechanism of iron alloy corrosion is assumed in which the controlling rate is diffusion of an iron–oxygen species, probably a FeO–Na_2O complex. A mathematical model is developed for the corrosion, and the predicted results agree with the experimental data. The corroding species is probably present in sodium at concentrations of $\sim 10^{-8}$ g Fe/g Na. (D.L.C.)

32085 (LADC-6026) SOME OBSERVATIONS ATTRIBUTED TO THE EFFECTS OF IMPURITIES IN TANTALUM. L. D. Kirkbride, D. N. Dunning, W. E. Ferguson, and R. H. Perkins (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 33p. (CONF-495-2)

From Golden Gate Metals Conference, San Francisco, Feb. 1964.

Many phenomenological observations of the corrosion behavior of tantalum in molten plutonium alloys have been recorded. This paper describes some of these experimental data and inductively relates the observed effects to the impurity content of the tantalum containers. Specific topics discussed are: (1) effects of small alloying additions to tantalum on its corrosion performance, (2) annealing treatments and their effects on grain boundary precipitates and intergranular penetration by plutonium, and (3) weld contamination. (auth)

32086 (NASA-CR-54066) CORROSION PRODUCT SEPARATION IN A CROLOY 9M MERCURY LOOP. Quarterly Report No. 4, February 1–April 30, 1964. D. B. Cooper and E. J. Vargo (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). May 11, 1964. Contract NAS-3-2538. 36p. (TM-3928)

The operation of a Croloy 9M, forced circulation, mercury loop in order to explore the engineering concept of corrosion product separation by hot trapping and magnetic means and also to evaluate the corrosion resistance of Croloy 9M is summarized. The loop is being studied in order to develop a mercury Rankine cycle power system for SNAP 8. (N.W.R.)

32087 (TID-20777(p.2-4)) POISONING OF THE SURFACE OF PLATINUM METALS BY INTERMETALLIC COMPOUND FORMATION. W. Roger Buck, III and Henry Leidheiser, Jr. (Virginia Inst. for Scientific Research, Richmond).

Submitted to Nature.

Experiments were conducted on the relative effectiveness of Pt metals in catalyzing the dissolution of Sn in boiling 2M HCl under direct coupling (Sn ions freely bathing Pt metal) and external coupling (with and without Sn ions in Pt metal chamber) conditions. The results show that, in the absence of Sn ions, all the Pt metal catalyze strongly the dissolution of Sn; Pt and Ir are not seriously poisoned by Sn ions; and Rh and Pd are strongly poisoned by Sn ions. Further experiments using Pd were carried out which show that $PdSn_4$ is formed on the Pd surface. (D.L.C.)

32088 (TID-20777(p.11-24)) THE RATES OF DISSOLUTION OF ORDERED AND DISORDERED Cu_3Au. J. Samuel Gillespie, Jr. and Henry Leidheiser, Jr. (Virginia Inst. for Scientific Research, Richmond).

In order to test the nearest-neighbor theory of corrosion of two-component solid-solution alloys, a study was conducted of the corrosion of ordered and disordered Cu_3Au. Various corrosive media were evaluated, and 0.01 M $FeCl_3$ adjusted to pH 2.0 with HCl was selected. Corrosion runs were made at 30°C, and the corrosion rates were found to be sensitive to handling, particularly for the ordered samples. The ratio of corrosion rate of disordered samples to that of ordered samples ranged from 2 to 3, depending on surface pretreatment. Corrosion rates of Cu–Au alloys containing 2.5 to 10 at.% Au in acidified 0.01 M $FeCl_3$ were also determined and compared with those predicted by the nearest-neighbor theory. It is concluded that Cu–Au alloys do not provide an adequate test for the nearest-neighbor theory. (D.L.C.)

32089 (TID-20777(p.25-32)) A NEAREST NEIGHBOR THEORY FOR CORROSION OF TWO-COMPONENT SOLID-SOLUTION ALLOY SYSTEMS. Henry Leidheiser, Jr. (Virginia Inst. for Scientific Research, Richmond).

A method is described for calculating the corrosion rates of certain types of solid-solution alloys A–B as a function of composition. In this method, the corrosion rate, which is determined by the rate of nucleation of active anodic states, is taken to be equal to the corrosion rate of pure component A multiplied by the fraction of atoms in the surface having all A atoms for nearest neighbors, plus the corrosion rate of pure component B multiplied by the fraction of B atoms in the alloy. Rates calculated in this manner are compared with experimental data for the corrosion of Cu–Ni alloys in 3% NaCl at 80°, Co–Ni alloys in boiling 0.6 M HCl and 0.6 M H_3PO_4, and Ni–Cr alloys in 0.01 N H_2SO_4 at 25°. Corrosion of Ag–Pd alloys in boiling HCl is also discussed. The method predicts that ordered alloys of the A_3B type should have a lower corrosion rate than disordered alloys of the same composition. (D.L.C.)

32090 (UCRL-7836) EFFECTS OF WATER VAPOR AND OTHER GASES ON URANIUM, THORIUM, PLUTONIUM, AND CARBIDES. A BIBLIOGRAPHY. Brigitta M. Dobratz (California. Univ., Livermore. Lawrence Radiation Lab.). [1964]. Contract W-7405-eng-48. 18p.

A total of 90 references is presented on the corrosive effects of water vapor, steam, moist air, and other gases on Pu, Th, and U and their carbides. The references cover the period 1951 to 1964, and a subject index is included. (D.L.C.)

32091 COMMENT ON "THE PARABOLIC OXIDATION KINETICS OF ALPHA–ZIRCONIUM AT 850°C." G. Oestberg (Aktiebolaget Atomenergi, Stockholm). Acta Met., 12: 947(Aug. 1964).

Previous results on the oxidation kinetics of α–Zr at 850°C (Wallwork et al., Acta Met., 12: 409(1964)) are evaluated. Particular attention is given to the finding that the variation in hardness with depth under the surface deviates notably from a single phase diffusion curve. Part of the difference in hardness variation may be accounted for by the hardening influence of ordering as such, but it is believed that it also indicates a difference in diffusivity of oxygen. Provided that a curve for oxygen penetration follows the same trend as the variation in hardness, it is tentatively suggested that the latter implies a higher diffusion constant for the ordered state than for the disordered solution. Comment is also made on the conversion of hardness numbers into oxygen content of α–Zr. (P.C.H.)

32092 LOCALIZED OXIDATION RATES ON GRAPHITE SURFACES BY OPTICAL MICROSCOPY. John M. Thomas and E. E. Glenda Hughes (University Coll. of North Wales, Bangor, U. K.). Carbon, 1: 209-14(Feb. 1964).

Previously published data relating to the oxidation of graphite were obtained, almost without exception, from measurements of mass loss of the solid or by analysis of the products of reaction. An attempt was made to obtain the overall activation energies associated with the oxidation of graphite single crystals, by oxygen, along the $\langle 10\bar{1}0 \rangle$ and $\langle 11\bar{2}0 \rangle$ directions by measuring directly, using optical microscopy, the rate of expansion of hexagonal etch pits and the rate of movement of surface steps. Activation energies that are significantly greater than those obtained using conventional methods were determined in the temperature range 800 to 875°C, the values for the $\langle 10\bar{1}0 \rangle$ and $\langle 11\bar{2}0 \rangle$ directions being, respectively, 66 ± 5 and 62 ± 2 kcal $mole^{-1}$. (auth)

32093 CORROSION OF SOME SPECIAL ALUMINUM ALLOYS FOR REACTOR CONSTRUCTION IN WATER UP TO 100°C. H. Spindler, W. H. Hauthal, and D. Rettig. (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 7: 291-9(May 1964). (In German)

Pure aluminum, a number of aluminum–nickel–iron alloys, and a number of aluminum–silicon–nickel alloys were submerged in ultra-pure water at 25, 50, and 100°C for 30 days and examined for corrosion phenomena. The results obtained at 25°C differed from those obtained at the two higher testing temperatures while the latter two did not differ significantly. Silicon inhibits the corrosion rate, regardless of concentration. Hydration of the oxide layer formed in water increases with increased exposure time; after the entire layer hydratized, the action of the galvanic microelements between aluminum and alloying metals becomes evident. Hydration rate is affected by exposure time, temperature, and composition. (OTS)

32094 STUDY OF THE KINETICS OF OXIDATION OF IODIDE NIOBIUM REMELTED BY THE ELECTRON BEAM METHOD. I. I. Korobkov, B. N. Revyakin, and He-ming Chen. Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 4, 93-109(1963).

The oxidation of iodide niobium was carried out in O_2 at a pressure of 150 mm Hg, and rate was determined by continuous weighing to within 3.10^{-5}–2.10^{-6} g. The rate of O of pure Nb was higher than that of the technical. At 350–450°C oxidation takes place at first in accordance with the parabolic law and then according to the linear. Decrease of the rate of oxidation with increase of temperature > 600°C was correlated with a sharp increase of thickness of the dark sublayer of the oxide. Analogous anomalous decrease of oxidation rate with increase of temperature was observed at 900-950 and 1000-1100°C. The oxidation of Me occurs with preferential diffusion of O_2 through the oxide

film toward the Me. Composition of the oxide film depends substantially on the temperature of the oxidation. On attainment of a certain critical thickness there begins a breakup of the oxide film associated with the formation of internal stresses in the film due to difference in specific volume of oxide and Me. The rate of oxidation of Nb according to the linear law rises with increasing pressure of O_2. During the oxidation according to the parabolic law the pressure of O_2 does not affect the rate of the process. (OTS)

32095 STRESS-CORROSION CRACKING OF AUSTENITIC STAINLESS STEEL IN HIGH TEMPERATURE WATER. Seiji Onishi, Jun Nakamura, et al. (Mitsubishi Nippon Heavy Industry, Japan). Mitsubishi Nippon Juko Giho, 4: 131-44(Dec. 1963). (In Japanese)

Recently, austenitic stainless steel is generally used to build atomic reactors. It has been reported that troubles occur from the stress-corrosion cracking of austenitic stainless steel under some conditions. Specifically in marine atomic reactors there is fear that acceleration of stress-corrosion cracking will result from wetting and drying of the reactor wall by cooling water according to the rolling of ships. Experiments were made on the following matters: effects of the wetting and drying of specimens; effects of the chemical composition, welding, and heat treatment of materials; effects of the purity of water and the surface contamination of specimens. (auth)

32096 OXIDATION OF METALLIC NEODYMIUM AND THE RATE OF THE C → A POLYMORPHIC TRANSFORMATION OF Nd_2O_3. V. B. Glushkova, Yu. G. Sokolov, and E. K. Keler (Grebenshchikov Inst. of Chemistry of Silicates, Leningrad). Zh. Fiz. Khim., 38: 1126-34(May 1964). (In Russian)

A procedure was devised for the systematic study of the oxidation equilibrium and kinetics over a wide range of pressures and temperatures. The oxidation of metallic neodymium in dry oxygen and in air was investigated. It was shown that the A form of Nd_2O_3 is produced on oxidation in dry oxygen at 250 to 500°C. This was found to be the only stable form of the sesquioxide of neodymium up to 1200°C. Investigation of the rate of the transformation C → A of Nd_2O_3 showed that it depends upon the degree of perfection of the crystal lattice of the metastable C form. (auth)

32097 METHOD FOR THE PRODUCTION OF CORROSION RESISTANT BERYLLIUM. Thomas Raine and James Alan Robinson (Associated Electrical Industries Ltd.). German Patent 1,164,671. Mar. 5, 1964. Priority date June 22, 1959, Great Britain.

A method is described for the production of beryllium which is especially resistant to carbon dioxide at high temperatures. Raw beryllium is melted under vacuum or under an inert gas atmosphere with the help of an electric arc, and the liquid beryllium is solidified very fast in a copper pot. (Gmelin Inst)

Fabrication

32098 (A/CONF.28/P/238) FABRICATION OF SOLID FUELS FOR FAST REACTORS. R. E. Macherey (Argonne National Lab., Ill.), H. W. Alter, and A. A. Shoudy. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of work on fabrication of solid fast reactor fuels which was carried out since the 1958 Geneva conference. The fuel materials studied included U–Pu–Fz alloys, UO_2–PuO_2, UC–PuC, U–Pu cermets, and Th–U alloys. (D.L.C.)

32099 (AERE-M-1218) FINAL REPORT ON THE HXT PROCESS FOR MAKING TUBES OF PYROLYTIC CARBON. K. W. Carley-Macauly and M. Mackenzie (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1963. 10p.

A description is given of the final stages of experiment on the HXT process in which tubes of very porous carbon are impregnated and consolidated with carbon deposited from a hydrocarbon gas. The main report, issued previously, described the process in detail; this paper supplements it with information on the microstructure of the HXT material and with a final consideration of the effect on the product of the hydrocarbon gas and base materials used. It is concluded that baked cotton wool impregnated with methane alone provides final radial permeabilities in the region of 10^{-9} to 10^{-10} cm^2/sec, and that a more homogeneous and reproducible product is obtained by direct contact of the baked matrix with the electrical heating element, than by separation of the two. (auth)

32100 (AERE-M-1261) INTERIM REPORT ON THE ELECTROHYDRAULIC CRUSHING OF REFRACTORY MATERIALS. N. G. Maroudas and R. F. Taylor (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1963. Declassified May 1964. 32p.

An investigation has been made into the comminution of certain refractory materials by means of the high intensity shock waves generated by underwater spark discharge. Though local pressures of several tens of thousands of atmospheres may be produced, no trouble has been found in using crushing cells of only 20–100 ml volume. For much of the work, a discharge voltage of 20 kv has been used with an energy dissipation of 1–10 joules per pulse. Materials such as marble, sintered urania, glass, high density alumina, and silicon carbide have been effectively crushed to products which commonly contain a large proportion of fines. At present, the figures for energy consumption are five to ten times higher than those for typical mechanical crushers, but on the other hand they are many times lower than any previously quoted for electrohydraulic crushers. The increases in efficiency have been brought about by decreases in circuit inductance. Electrohydraulic crushers may be of advantage for remote crushing of active material for they have no moving parts. (auth)

32101 (GEAP-4557) FABRICATION OF FUEL CLADDING FROM INCOLOY ALLOY 800. AN EVALUATION OF METHODS. R. F. Kirby, D. F. MacMillan, and J. R. Punches (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 1964. Contract AT(04-3)-189. 52p.

On the basis of its high temperature physical and corrosion properties, Incoloy Alloy 800 was selected as a candidate for fuel cladding in nuclear superheat applications. At the time of its selection, there was little information or experience with Incoloy 800 in the production of thin-walled, small diameter tubing suitable for nuclear fuel cladding. As a result, special purchasing efforts were required for the procurement of initial tubing used in fuel fabrication. As-received welded and drawn tubing proved to be generally good but showed some conditions which were undesirable, the major one being lack of complete recrystallization and homogeniza-

tion of the weld zone. The possible effect of this condition upon the fuel performance was not immediately known; however, subsequent development work indicated that the nonhomogeneity of the weld could affect adversely its mechanical and corrosion properties in relation to the parent metal. A development program was initiated to determine treatment sequences suitable for the fabrication of welded and drawn tubing with a fully recrystallized and homogenized weld structure. This was accomplished by butt welding lengths of Incoloy strip which were subsequently cold rolled and annealed to simulate tube fabrication steps. Requirements imposed on this work were that all processes developed must be amenable to normal production equipment and procedures used in commercial tube manufacturing. As a result of the experiments undertaken, a sequence of cold drawing and annealing steps was established suitable for recrystallization and homogenization of weld zones in welded-and-drawn tubing. In order to obtain complete sequential chemical and metallurgical history of nuclear grade Incoloy 800 tubing, a 3000-pound ingot was purchased to the required chemical specifications and reduced to tubing through both seamless and welded and drawn routes. The management of the sequential metallurgical steps needed for tubing fabrication resulted in establishing a workable process through a series of reliable vendors. By providing these vendors with the appropriate basic technical support through the tubing production stages, a total yield of 85 percent was obtained in producing nuclear grade tubing from the ingot. Much of the basic information needed to support vendor processing of the Incoloy ingot was obtained from the experiments described in this report. This activity resulted in not only enhancing the understanding of the properties of Incoloy 800 but illustrated that the practical steps needed for good quality tubing were within the capability of the vendors. The results from this program have undoubtedly helped in increasing the number of potential vendors and reducing the price of high quality tubing needed for fuel element fabrication. (auth)

32102 (HW-80566) PROCUREMENT OF ZIRCALOY-2 PROCESS TUBES FOR N-REACTOR. R. C. Aungst and D. H. Curtiss (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1964. Contract AT(45-1)-1350. 84p.

An industrial capability has been developed for the fabrication of large heavy-walled Zircaloy-2 process tubes for N-Reactor. This was done by cooperative technological development between Hanford and a number of fabricators and by the evolution of contracting procedures that put progressively greater responsibility on the vendor. Eventually 1064 finished N-Reactor process tubes were delivered by three vendors under four contracts. Tube quality was excellent with less than 3% being rejected at Hanford by rigorous inspection procedures not required of the vendor at his plant. (auth)

32103 (HW-SA-3543) AN ANALYSIS OF THE FABRICATION COST OF PLUTONIUM-ENRICHED FUEL ELEMENTS. Clarence Howard Bloomster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 25, 1964. Contract [AT(45-1)-1350]. 53p.

Thesis submitted to Univ. of Washington, Seattle.

The cost of fabricating plutonium fuel elements will be one of the prime considerations in fueling commercial nuclear power reactors with plutonium. An examination is made of the cost of fabricating plutonium fuel elements for the Plutonium Recycle Test Reactor. The fuel elements are prototypical of power reactor fuel elements. The objective of the examination is twofold: First, to determine the cost of fabricating plutonium fuel elements and second, to estimate the difference in fabrication cost between plutonium enriched and enriched uranium fuel elements. The fabrication process, plutonium fuel technology, and the utilization of plutonium in nuclear reactors are described. The elements of the cost of fabrication are analyzed in detail. The analysis indicates that plutonium fuel elements can be fabricated both safely and economically. The fabrication cost of the plutonium fuel element was approximately ten percent greater than the fabrication cost of comparable enriched uranium fuel elements. (auth)

32104 (KFK-158) BESTRAHLUNGSSTIMULIERTE EINEBNUNG AN KUPFEROBERFLÄCHEN. (Irradiation-Induced Polishing of Copper Surfaces). Ulrich Daeunert (Kernforschungszentrum. Institut für Angewandte Reaktorphysik, Karlsruhe, Germany). Feb. 1964. 95p.

The effect of 5.3-Mev α radiation on the structure of single-crystal Cu surfaces was investigated electron microscopically. At an irradiation dose of about 10^{16} α/cm^2 at room temperature a complete flattening of the originally rough surface was observed. (The surface structure was composed of parallel wedge-shaped furrows with a separation of some 1000 Å.) This effect was compared with a thermally activated polishing and described with a diffusion mechanism. From the dependence of the polishing velocity on the distance between adjacent surface furrows, the nature of the predominant processes, volume diffusion or surface diffusion, could be experimentally identified. It was found that a flattening occurs with the fourth power of the structure wavelength so that shorter wavelengths disappear faster. According to a theory of thermal surface flattening, developed by W. W. Mullins, which was expanded to the case of radioinduced polishing, this behavior was a type of surface diffusion. The surface flattening was explained by a mass current along the surface, which was excited by surface stress and caused by lattice vacancies formed near the surface during high concentration irradiation. A radioinduced vacancy production stimulated diffusion processes to such an extent that polishing effects, which required some 10^{10} years for a comparable thermal diffusion, were obtained in several hours. The radioinduced flattening process was completely described with a polishing equation, and its coefficients were experimentally determined. (tr-auth)

32105 (NAA-SR-Memo-8988) HOT PRESSING FOR NUCLEAR APPLICATIONS OF BeO: PROCESS, PRODUCT, AND PROPERTIES. S. C. Carniglia, R. E. Johnson, A. C. Hott, and G. G. Bentle (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 15, 1963. Contract AT(11-1)-Gen-8. 56p. (CONF-281-51)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Hot pressing has played a prominent part in research programs studying beryllium oxide, and has been considered on several occasions as a possible production tool. The desirable characteristics of the hot press are described by reference to advanced designs in three forms: (a) the basic research tool; (b) the vacuum hot press; and (c) the continuous hot press for production use. Techniques of operation have been learned for the reliable preparation of sound, uniform, high-purity BeO bodies of simultaneously very high density (99.7 to 100.0% of T.D.) and fine grain size (to a limit of 10 μ average). The routine consists of a dwell at temperature without the application of

pressure, an optimized time-temperature-pressure cycle, and rapid heating and cooling ramps. The parametric relations are described. Techniques for the controlled preparation of BeO of ultrafine grain size at somewhat less than full density have also been worked out. The resultant material parameters and corresponding mechanical characteristics are discussed, with particular reference to modulus of rupture at high temperatures and to the influence of microstructure on resistance to fast neutron irradiation damage. Average strengths of 48,000 psi at 1500°C have been recorded. The microstructural, size, and shape limitations of hot-pressed BeO are reviewed with respect to reactor core requirements. Illustrations are taken from past experience to describe the preparation of hot pressed shapes as reactor component parts and the desired manner of conducting production runs. Cost elements of an hypothetical production activity are displayed, assuming continuous hot press operation and based on American economic conditions. A typical cold-form-and-sinter operation is described for comparison. (auth)

32106 (NLCO-912) AN IMPROVED PRODUCTION FURNACE COIL ASSEMBLY FOR URANIUM. George M. Shera and Robert J. Lusky (National Lead Co. of Ohio, Cincinnati). June 9, 1964. Contract AT(30-1)-1156. 21p. (CONF-603-2)

From Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June-July 1964.

An improved induction coil assembly was developed for the vacuum furnaces in which uranium is remelted and cast into ingots. Details of a new support material, refractory ring lining, and granular thermal insulation used in the construction of the assembly are listed. No arcing between coil turns or coil leads was observed, and the higher thermal efficiency of the improved coil assemblies has made it possible to reduce the furnace power cycle. The new assembly was shown to have excellent resistance to damage by metal spills. (auth)

32107 (NP-14128) ARC-CAST MOLYBDENUM-BASE ALLOYS (1962–1964). M. Semchyshen, Robert Q. Barr, and E. Kalns (Climax Molybdenum Co. of Michigan, Detroit). May 1964. Contract Nonr-2390(00). 104p.

The influence of in-process solution and solution and aging treatments on the properties of several molybdenum-base alloys is described. Alloys of molybdenum with titanium and/or zirconium were processed to bar stock by extrusion and rolling procedures. Extruded bars were prepared for rolling or final size either by heating to the minimum recrystallization temperature or by the application of optimum solution or solution and aging treatments. The latter procedures resulted in significantly higher recrystallization temperatures and tensile strengths than the procedure involving recrystallization prior to rolling. The high elevated temperature strengths obtained for the molybdenum-base alloys studied resulted from a critically dispersed carbide phase. A limited amount of work indicated that a dispersion hardenable molybdenum–beryllium alloy could be worked by extrusion. Room temperature hardnesses approaching 500 DPH were developed by the application of the proper solution and aging treatments to the extruded molybdenum–beryllium alloy. (auth)

32108 (ORNL-P-123) EXPERIENCE IN THE FABRICATION OF URANIUM-233 BEARING ThO_2–UO_2 RODS IN A LIGHTLY SHIELDED FACILITY AT ORNL. J. E. Van Cleve, Jr., and A. L. Lotts (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 23p. (CONF-315-2)

From Norton Company's Symposium on the Technology of Powder Filled UO_2 Fuel Elements, Worchester, Mass., Nov. 1963.

A description is given of the operating experience of the rod fabrication portion of the Kilorod Facility. The results has proven the feasibility of a bulk oxide vibratory compaction method of fuel element fabrication. Rods of 90 ± 2% theoretical density have been fabricated. (D.L.C.)

32109 (WADD-TR-61-72(Vol.IX)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME IX. FABRICATION AND PROPERTIES OF CARBONIZED CLOTH COMPOSITES. W. C. Beasley, E. R. McHenry, and E. L. Piper (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). Feb. 1964. Contract AF33(616)-6915. 107p.

This report describes the development of fibrous, carbonaceous composites and laminates. Graphite, carbon, and heat-treated cloth and graphite and carbon felts are evaluated as fillers. Physical properties of the carbonized and graphitized forms of these materials are tabulated. Test results of these materials as potential hardware components are presented. (auth)

32110 (WADD-TR-61-72(Vol.XII)(Suppl.)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. SUPPLEMENT TO VOLUME XII. DEVELOPMENT OF AN IMPROVED LARGE DIAMETER, FINE GRAIN GRAPHITE FOR AEROSPACE APPLICATIONS. R. L. Racicot and C. W. Waters (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). Aug. 1963. Contract AF33(616)-6915. 37p.

This report covers the continuation of development work on large diameter grade RVA graphite. The extension work consisted primarily of fabricating and evaluating raw materials for use as the inert filler in RVA blends, and of attempts to scale up to longer lengths of RVA graphite. Significant properties of raw materials, as they affect the final properties of grade RVA graphite, were the total porosity and kerosene apparent density. The more porous raw materials imparted higher strength to the finished RVA graphite, whereas those of higher density contributed to higher density of the finished graphite. Long lengths of 33-inch diameter RVA graphite were difficult to process without cracking. The longest length processed successfully under this project was 45 inches. (auth)

32111 (WADD-TR-61-72(Vol.XIII)(Suppl.)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. SUPPLEMENT TO VOLUME XIII. DEVELOPMENT OF A FINE-GRAIN ISOTROPIC GRAPHITE FOR STRUCTURAL AND SUBSTRATE APPLICATIONS. R. A. Howard and R. L. Racicot (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). July 1963. Contract AF33(616)-6915. 20p.

This report covers the characterization of grade RVC graphite and describes process and blend variations which have been studied in the fabrication of substrate-type graphite since the publication of WADD Technical Report 61-72, Volume XIII. Present trials show that a forming pressure of 900 lbs/in.^{2}, instead of the 1000 lbs/in.^{2} as used previously, would increase the yield of grade RVC and not significantly change the properties of the material. Furthermore, these trials show that various other blends will also produce a substrate graphite suitable for silicon carbide coating. (auth)

32112 (WADD-TR-61-72(Vol.XXXI)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXI. IMPREGNATION OF GRAPHITE. C. E. Waylett, M. B. Carter, and M. A. Spring (National Carbon

Co. Advanced Materials Lab., Lawrenceburg, Tenn.). July 1963. Contract AF33(616)-6915. 63p.

This report discusses the impregnation of carbon and graphite materials with carbonaceous liquids and the subsequent heat treatment required to convert these liquids to coke and graphite in the pores of the base materials. The purpose of the impregnation process is to increase the strength and density and decrease the porosity of the finished articles. Impregnation procedures, the natures of the impregnants, and base stock structure affect the physical properties of impregnated graphite. Mercury porosimetry is used to define the pore structure of the bodies to be impregnated and aid in selection of impregnant and impregnating procedure. The physical properties of the impregnated graphite are related to the performance of nozzle inserts in a sub-scale solid propellant rocket motor. (auth)

32113 (WADD-TR-61-72(Vol.XL)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XL. THE INFLUENCE OF FILLERS ON THE PYROLYSIS AND BONDING CHARACTERISTICS OF CERTAIN SYNTHETIC BINDERS. C. W. Boquist, H. J. O'Neil, R. E. Putcher, and J. S. Griffith (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 1963. Contract AF33(616)-6915. 51p.

The work described presents the concluding part of a program concerned with the bonding and pyrolysis characteristics of two synthetic binders. The binders, alumina-condensed furfuryl alcohol resin and acenaphthylene pitch, were evaluated both by themselves and in conjunction with selected fillers to determine binder-filler interactions during pyrolysis and to develop a more complete understanding of the carbon bonding process. The data accumulated from a number of techniques are presented and interpreted. Pyrolysis and physical property data for specimens molded with both the resin and pitch binders are also presented. It has been found that some fillers are essentially unbondable by carbon, while others can materially alter binder pyrolysis. (auth)

32114 (AI-Trans-48) VARIOUS ASPECTS OF WELDING PROBLEMS PECULIAR TO THE NUCLEAR INDUSTRY. H. Foulquier. Translated by Anthony Cornell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), from a Brochure of the Saclay Nuclear Studies Center. [nd]. 19p.

To be published in Z. Metallk.

The welding of fuel elements is discussed. Resistance welding cycles are given for fuel elements for EDF 1 and EDF 2. The electron beam welding of EL 3 and EL 4 fuel elements is discussed. The core of the EL 4 Reactor is described, and the electron beam machine for welding the pressure tubes is discussed in detail. The operation and performance of the machine are described. (D.L.C.)

32115 (EURAEC-1018) STUDY OF ELEMENTARY CRACKING WELDING PROCEDURE — PRELIMINARY PROTOTYPE STUDY. Quarterly Report No. 5, January 1–March 31, 1964. (Institut de Soudure, Paris). Apr. 30, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 090-62-12 RDF. 15p. (A translation)

The welding of deposits on Y sections using the MIG process is studied on manganese–molybdenum steels. The hardnesses on transversal cross-sections of deposited beads are investigated. Cracking of the welds is studied with respect to preheating and clamping temperature and with the study of the heat cycle connected with the experimental welding conditions. A metallographical examination is made of cross sections perpared by oxygen jet double-U chamfering (J-grooving). (N.W.R.)

32116 COATING IN THE PRODUCTION OF NUCLEAR FUEL ELEMENTS. H. Huschka (Nuklear-Chemie und-Metallurgie GmbH, Hanau, Ger.). Atomwirtschaft, 9: 265-8(June 1964). (In German)

In addition to the use of nuclear fuels in a compact state, e.g., as metals, alloys, oxides or carbides, there is, in special cases, an interest in the application of such fuels in a dispersed form. Examples are uranium oxide particles in a metallic matrix or carbide particles in the case of high-temperature elements or U_3O_8-aluminum cermets in the case of some MTR elements. A special interest in coated particles arose in connection with this use of nuclear fuel in dispersed form. The reasons for this are typically connected with demands to surround the particles with a dense cladding in order to prevent the escape of fission products as well as to produce a close link between particles and surroundings in order to attain as nearly as possible an ideal dispersion. Corresponding to the large number of reactor and fuel element concepts recourse was made to various coating methods for the solution of the many problems. Spherical fuel elements of graphite were investigated to improve the oxidation stability, abrasion resistance and to seal the graphite pores by immersion in molten silicon to form an over-coat of silicon–silicon–carbide. The zirconium alloy used as a cladding material in the case of rod type fuel elements was treated with steam to develop a corrosion resistant zirconium oxide layer. Plate elements of uranium–aluminium alloy were plated with pure aluminium by a mechanical rolling process. Efforts are being made to coat ceramic fuel particles with metals by a chemical dipping process, etc. Molybdenum and pyrolitic carbon appear to be suitable materials for ceramic coatings for fuel particles. (auth)

32117 PREPARATION OF URANIUM POWDER BY HYDRIDATION-DECOMPOSITION OF METALLIC URANIUM. R. De Anca, G. Gerboles, and J. M. Jimenez (Junta Energia Nuclear, [Madrid]). Energia Nucl. (Madrid), 8: 4-11(Jan.-Mar. 1964). (In Spanish)

The experimental results on the preparation of uranium powder by hydridation of metallic uranium with subsequent decomposition are reported. The method followed is described, and the results obtained with shavings, powders, and rods of uranium are given. It was concluded that the hydridation reaction is simple, relatively rapid, and high yielding. The decomposition of the hydride in vacuum at 350 to 400°C gave a grey, very porous powder. (J.S.R.)

32118 THE VIBRATORY PACKING OF POWDERS. P. E. Evans and R. S. Millman (Univ. of Manchester, Eng.). Powder Met., 7: 50-63(1964).

The objective, in packing particles by vibration, is to increase the density of packing. The main factors affecting the packing of particles in this way are the characteristics of the powder (size distribution, shape, surface condition) and the vibration variables (frequency, amplitude, time). Other factors include segregation by size and shape and also, for a multicomponent powder, by particle density. The wall effect of the container might also be expected to influence the packing in its vicinity. An experimental investigation of some of these variables is reported. (auth)

32119 SPECIAL FABRICATION TECHNIQUES. Reactor Mater., 7: No. 2, 139-48(Summer 1964).

Research and development progress on melting, hot and cold working, cladding procedures, welding and brazing,

explosive forming, and nondestructive testing is reviewed. (69 references). (N.W.R.)

32120 PROCEDURE FOR STRIPPING ANODIC OXIDE FILMS FROM TANTALUM AND NIOBIUM. R. E. Pawel (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 35: 1066-7(Aug. 1964).

A technique is described by which sections of metal about 100 Å in thickness can be consecutively removed from suitably prepared niobium and tantalum surfaces. (D.C.W.)

32121 PREPARATION OF NIOBIUM AND TANTALUM FROM THE VAPOR PHASE. Ya. M. Polyakov, L. A. Nisel'son, and A. N. Krestovnikov. Tsvetn. Metal., No. 1, 131-8(1964).

The production of niobium and tantalum coatings, deposited from the vapor phase onto steel, iron, copper, nickel, molybdenum, tungsten, graphite, and quartz, is one of the most important uses of Nb and Ta. Thermal dissociation of $NbCl_5$, $NbBr_5$, NbI_5, $TaCl_5$, $TaBr_5$, and TaI_5 yields metals of highest purity. The reduction of niobium and tantalum pentachlorides by hydrogen is at present the most economical manufacturing technique. Reduction of niobium and tantalum halides, combined with those of alloying admixtures, may open the way to creation of Nb- and Ta-based Ti, Zr, Al, W, Mo, and Sn alloys. Thermal curves for the deposition of Nb and Ta–pentahalides on the kinetics of niobium iodide refining are discussed. A maximum Nb-deposition rate of 30 g/hr was reached at 650°K in the reactor and 1135°K on the 1500 mm long thread. (TCO)

32122 BRAZING OF CERAMICS. C. W. Fox and G. M. Slaughter (Oak Ridge National Lab., Tenn.). Welding J. (N. Y.), 43: 591-7(July 1964).

A program was undertaken to develop simplified procedures that would be particularly applicable to high-temperature nuclear reactor uses. Brazing alloys such as 48 Ti–48 Zr–4 Be (wt %) and 49 Ti–49 Cu–2 Be (wt %) were found to readily flow on oxide and graphite ceramics. Several demonstration fuel element assemblies were fabricated to illustrate the usefulness of these procedures for nuclear applications. One of these assemblies contained graphite tubes and end caps, which were brazed to a molybdenum hanger. Another demonstration fuel element was composed of a compartmented aluminum oxide plate to which aluminum oxide cover plates were brazed. In addition, a wide variety of ceramic-to-metal joint assemblies was fabricated, including electrical insulation components (aluminum oxide-to-stainless steel) and a synthetic sapphire Hall cell. (P.C.H.)

32123 ELECTRON BEAM WELDING OF BRAZED REFRACTORY JOINTS. Mel Schwartz (Martin Co., Baltimore). 27p. (CONF-407-2)

From Electro Chemical Society, Toronto, May 1964.

Investigations were made on the electron beam welding of brazed refractory joints. Power and weld speed settings were established for welding 0.008 in. D-36 (Nb-10 Ti-5 Zr) and TZM (Mo-0.5 Ti-0.08 Zr) molybdenum. The settings were then used to make welds necessary in the fabrication of a D-36 brazed honeycomb heat shield panel and a TZM brazed honeycomb structural panel. The effects of the honeycomb pattern, brazed onto the under side of the refractory sheet that was electron beam welded, and the effect of the braze alloy itself in the weld nugget were studied. The results were applied to the fabrication of brazed refractory honeycomb panels. Conditions and methods for the welding are listed. (P.C.H.)

32124 IMPROVEMENTS IN OR RELATING TO METHODS OF MANUFACTURING ELEMENTS OF FISSILE OR BREEDING SUBSTANCES FOR USE IN NUCLEAR REACTORS. (to Stichting Reactor Centrum Nederland). British Patent 962,428. July 1, 1964. Priority date Sept. 18, 1959, Netherlands.

A method of manufacturing an element of fissile or breeding substance, in which the substance is mixed with a gel of a fluoride of a metal of the alkaline earth group, compressed by moulding or extrusion, and dried at 50 to 400°C, is discussed. Examples of the process are given for BeF_2, CaF_2, and MgF_2. (L.B.S.)

32125 CARBON ARTICLES. Robert Lewis Bickerdike and Garyth Hughes (to Minister of Aviation). British Patent 962,634. July 1, 1964. Filed Nov. 20, 1959.

The process for and several examples of production of carbon articles having a density greater than 1.7 gm/cm^3, a bond strength greater than 7800 psi, and a compression strength greater than 35,000 psi are described. (L.B.S.)

32126 METHOD FOR THE FABRICATION OF FORMED BODIES OF URANIUM CARBIDE. André Accary and Jacques Dubuisson (to Commissariat à l'Énergie Atomique). German Patent 1,165,280. Mar. 12, 1964. Priority date Nov. 6, 1959, France.

A powder mixture of uranium and graphite of the desired composition is compacted and sintered at temperatures lower than the melting point of the uranium in vacuo. The powder mixture is first compacted mechanically until an average density of 5 is obtained, and then it is heated in vacuo starting at about 250°C until a final temperature of 1200°C is achieved. (Gmelin Inst.)

32127 PROCESSES FOR THE PRODUCTION OF CERAMIC BODIES. David Thomas Livey, Peter Murray, and Jack Williams (United Kingdom Atomic Energy Authority). U. S. Patent 3,141,782. July 21, 1964. Priority date Mar. 14, 1957, Great Britain.

A simple process for the production of high-density ceramic bodies from refractory metal oxides at moderate temperatures is described. If the crystallite size of these metal oxides, as shown by surface area measurement and x-ray diffraction studies, is less than a critical size, about 0.1 to 0.25 micron for nonstoichiometric and about 0.1 micron for stoichiometric oxides, then strong high-density compacts of the oxides can be obtained by hot pressing at temperatures below 1000°C, using pressures less than or about 10 tons/$in.^2$ Examples of production of magnesium hydroxide, uranium dioxide, and beryllia are given. (M.J.T.)

32128 FUSION WELDING NIOBIUM ALLOYS WITH NICKEL ALLOYS. L. G. Strizhevskaya, M. V. Poplavko-Mikhaylov, and L. L. Starova. Russian Patent 160,553.

To join niobium alloys with nickel alloys by fusion welding an insert of a third metal (palladium) with good weldability was used in order to extend the range of welding temperatures. (OTS)

Properties and Structure

32129 (ANL-6816) INTERDIFFUSION BETWEEN URANIUM-5 w/o FISSIUM ALLOY AND TYPE 304 STAINLESS STEEL. C. M. Walter (Argonne National Lab., Ill.). Mar. 1964. Contract W-31-109-eng-38. 15p.

The compatibility of U-5 wt % Fs with Type 304 stainless steel was investigated in the temperature range from 550 to 700°C. Appreciable interdiffusion bands were detected, but only about 5% of the band was into the stainless steel while the bulk of the diffusion was into the

fuel. When the data obtained at the reference operating temperature of 550°C for EBR-II, Core I was extrapolated to the proposed recycle time of 7.8×10^6 sec (90 days), a value of 6.4×10^{-3} cm was found for the total band width. As the temperature increased, the diffusion band widened rapidly, more than doubling with each 50°C temperature increment until at 650°C it becomes 3.6×10^{-2} cm in 7.8×10^6 sec (90 days). The total band width, as determined metallographically, was taken as the depth of diffusion penetration. Electron microprobe analysis served to corroborate these findings. (auth)

32130 (ARL-64-63) THE AXIAL THERMAL EXPANSION OF TETRAGONAL ZIRCONIA BETWEEN 1150° AND 1700°C. S. M. Lang (Owens-Illinois Glass Co., Toledo). Mar. 9, 1964. Contract AF33(616)-7470. 25p.

The lattice constants for the tetragonal form of three different samples of zirconium dioxide (ZrO_2) were measured in a high-temperature x-ray diffractometer in the temperature range from about 1150 to about 1700°C in a normal barometric air atmosphere. Within the accuracy and precision limits of the diffraction measurements, the calculated lattice constants were the same for the three source materials but only after each had been subjected to a prior heat-treatment at 1550 to 1750°C in a normal barometric air atmosphere. The thermal expansions of the two axes are linear within the temperature range investigated and are given by the following equations: a-value = $3.5882 + 4.50 \times 10^{-5}$ (T), within 0.0013 Å; and c-value = $5.1882 + 7.57 \times 10^{-5}$ (T), within 0.0022 Å where T is in °C for the range between 1150 and 1700°C. These, probably, also apply for temperatures up to at least 2000°C. The lattice constants are a = 3.6399 Å and c = 5.2753 Å at 1150°C, and a = 3.6782 Å and c = 5.3397 Å at 1700°C. During the investigation, it was necessary to redetermine the axial expansions of BeO. These are given by the following equations: a-value = $2.6982 + 1.8714 \times 10^{-5}$ (T) + 8.0641×10^{-9} $(T)^2$; and, c-value = $4.3783 + 2.5620 \times 10^{-5}$ (T) + 1.2645×10^{-8} $(T)^2$ where T is in °C for the range between 28 and 1700°C. (auth)

32131 (ASD-TDR-63-360(Pt.II)) INVESTIGATION OF THE RELATIONSHIP OF TWINNING TO BRITTLE FRACTURE OF REFRACTORY METALS. C. N. Reid, A. Gilbert, and G. T. Hahn (Battelle Memorial Inst., Columbus, Ohio). May 1964. Contract AF33(657)-7376. 61p.

Tension, compression, and bend tests were used to investigate brittle fracture in both single-crystal and polycrystalline molybdenum samples of three contrasting compositions. Although in compression, twins were observed frequently to be responsible for transcrystalline and intercrystalline crack nucleation, during tension or bend tests, no failures were observed whose initiation could be ascribed to twinning. Even in single crystals stressed along [001], the fractures were not twin-induced. It is concluded that twins are just one of several heterogeneities competing in the formation of cracks and that in the material examined other heterogeneities were always dominant. Experiments were conducted on Mo–35Re in which the strain was recorded as a function of time during the formation of twinning bursts. The results indicate that twinning in this situation is essentially a sonic phenomenon. Dislocation arrangements were revealed in Fe–3Si by etch-pitting, and it was observed that the propensity for twinning under given conditions was identical in both the presence and absence of a strongly polygonized substructure. (auth)

32132 (ASD-TDR-63-741(Vol.I)(Suppl.I)) AEROSPACE STRUCTURAL METALS HANDBOOK. VOLUME I. FERROUS ALLOYS. V. Weiss and J. G. Sessler, eds. (Syracuse Univ., N. Y. Research Inst.). Dec. 1963. Contract AF33(616)-7792. 176p.

32133 (ASD-TDR-63-741(Vol.II)(Suppl.I)) AEROSPACE STRUCTURAL METALS HANDBOOK. VOLUME II. NON-FERROUS ALLOYS. V. Weiss and J. G. Sessler, eds. (Syracuse Univ., N. Y. Research Inst.). Dec. 1963. Contract AF33(616)-7792. 166p.

32134 (BM-RI-6480) ELECTRICAL RESISTIVITY OF CERIUM METAL FROM 4° TO 300°K. Robert D. Smith and E. Morrice (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Oct. 1963. 15p.

Thermal expansion and electrical resistance measurements were made on cerium metal from 4 to 300°K. The apparatus developed, including a specimen holder and a cryostat system, are described along with the experimental techniques used in obtaining the measurements. The total linear thermal expansion of 99.83 weight-percent cerium metal between 4°K and room temperature was 4.24 percent. The resistivity at 4°K was 7.0×10^{-6} ohm-centimeter. Data at 4°K indicate a fundamental relationship between residual resistivity and purity of cerium metal. The effects of annealing and repeated thermal cycling on resistivity were determined. (auth)

32135 (BMI-X-296) PROGRESS ON USAEC/AECL COOPERATIVE PROGRAM. Quarterly Report, March–May 1964. Stanley W. Porembka (Battelle Memorial Inst., Columbus, Ohio). June 5, 1964. Contract W-7405-eng-92. 17p.

The long term creep-rupture properties of sintered aluminum powder alloys (M-257, M-583, SAP-895, and SAP-915) are determined at 700, 800, and 900°C. The creep-rupture properties of annealed and cold-worked Zircaloy-2 sheet are determined at 550, 650, and 750°F. (N.W.R.)

32136 (BMI-X-10093) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report, April–June 1964. Thomas S. Elleman, George G. Cocks, David L. Morrison, and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). July 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 10p. (EURAEC-1132)

Solid-fission-product diffusion is studied in zirconium at 800, 1000, and 1150°C. The results for zirconium are still considered tentative, but diffusivities appear similar to those for zirconium self-diffusion. Xenon and krypton fission gas release is measured from urania specimens clad with 5 mils of the iron-20 wt % chromium alloy. The data suggest that the release observed is not due primarily to diffusion; rather it is considered probable that the release is occasioned by recoil from uranium contaminant in the cladding of the specimen. (N.W.R.)

32137 (CEA-R-2340) ETUDE DU REVENU À DIFFÉRENTES TEMPÉRATURES DE LA PHASE BÊTA RETENUE PAR TREMPE À L'EAU DANS LES ALLIAGES U–Cr CONTENANT DE 0.37 À 4 ATOMES % DE CHROME. (Studies on Tempering at Different Temperatures of the Beta Phase Retained by Water Quenching in Uranium–Chromium Alloys Containing from 0.37 to 4 Atomic Percent of Chromium). Michel Degois (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 53p.

Thesis submitted to Université, Nancy.

A systematic study was made of the annealing of the beta phase retained by water-quenching in uranium–chromium alloys of concentrations between 0.37 and 4 of chromium

percent. It is shown that alloys containing less than 1 at. per cent are tranformed at temperatures between room temperature and 250°C according to a bainitic process involving activation energies of the order of 14,500 cal/mole. Alloys containing more than 1 at. per cent are transformed at temperature between 400 and 650°C by way of a germination and growth process involving an activation energy of the order of 33,000 cal/mole. The limit of solubility of chromium in beta uranium plays a fundamental part in the transformations of the alloys. The TTT curves of beta → alpha transformation were drawn by the use of a thermodilatometer of very low inertia. The transformation law may be expressed $1 - x = \exp. - (kt)^n$; x represents the degree of progession of the transformation, k a coefficient dependent on the temperature, and n an exponent depending only on the composition of the alloy. A micrographic and crystallographic study confirmed the results found by dilatometry; in particular it was possible to measure the progression rates of the transformation. (auth)

32138 (DRI-2166) DETERMINATION OF THE NIOBIUM-RICH REGION OF THE TERNARY PHASE DIAGRAMS, NIOBIUM–TUNGSTEN–HAFNIUM AND NIOBIUM–TUNGSTEN–ZIRCONIUM. Quarterly Report No. 7. Albert S. Yamamoto (Denver. Univ. Denver Research Inst.). June 1964. Contract AT(11-1)-1092. 12p.

The second phase was identified as W_2Hf in a Nb–56W–27Hf alloy. The determination of the lattice spacings of the (Nb–W–Hf) solid solution phase in the 1100°C anneal alloys was discontinued because of the scattered data. A tentative isotherm at 1600°C for the niobium-rich region of niobium–tungsten–zirconium alloys was constructed as a result of the preliminary metallographic examination of the annealed structure. Microhardness data obtained for the niobium–tungsten–zirconium alloys both in the as-arc-melted state and the annealed condition at 1600°C are graphically presented. (auth)

32139 (HW-81269(p.5.1-23)) CHEMICAL METALLURGY. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The oxidation and corrosion properties of Zircaloy-2, Zircaloy-4, zirconium, aluminum, stainless steels, nickel alloys, and iron alloys are evaluated. The Hanford modified gas chromatograph using an ion cross section detector is described and its sensitivity is evaluated. The hydridation of Zircaloy-2 under supercharging conditions is studied. (N.W.R.)

32140 (KAPL-3019) PHASE RELATIONS IN THE HAFNIUM-RICH HAFNIUM–TIN SYSTEM. G. E. Wasielewski (Knolls Atomic Power Lab., Schenectady, N. Y.). June 15, 1964. Contract W-31-109-eng-52. 54p.

The hafnium-rich portion of the hafnium–tin system was determined using x-ray parametric, micrographic, and incipient melting techniques. A versatile experimental technique was developed for the heat treatment of powder which resulted mainly from considerations regarding the effects of the high temperatures necessary for a study of this alloy system. Hafnium–tin alloy powder was heat treated while in the vertex of Mendenall-type black-body wedge filaments. The filaments and powder were resistance heated and "quenched" by a high-pressure blast of pure argon. The resultant powder was used directly for x-ray parametric and phase identification studies. The solid solubility of tin in α–hafnium decreased nearly linearly from 9.9 wt % tin (1414 at. %) at 1680°C (3050°F) to 6.2 wt % tin (9.1 at. %) at 800°C (1470°F). The first hafnium-rich intermediate phase was established to be a Nowotny-type phase Hf_5Sn_3. Additions of tin slightly stabilized the bcc β-phase with the (α + β) field terminating at a eutectoid ($\beta \rightleftharpoons \alpha + Hf_5Sn_3$) at 1680°C (3050°F) and 10 to 11 wt % tin. The liquidus decreased with increasing tin to a eutectic ($L \rightleftharpoons \beta + Hf_5Sn_3$) at 1725°C (3125°F) and 14.6 wt % tin. The eutectic terminated at ~11.5 wt % tin, the maximum solubility in the β-phase. Factors affecting an anomalous variation of the α–hafnium c_0 parameter with tin content warrant additional study and may account for the differences noted between this and the analogous zirconium–tin system. The high solubility of tin in hafnium completely removes the possibility of brittle hafnium–tin compounds being the source of hafnium-to-Zircaloy butt-weld cracking. (auth)

32141 (LADC-5869) USE OF A LEAST SQUARES TECHNIQUE IN ESTIMATING DIFFUSION PARAMETERS. A. S. Goldman and R. E. Tate (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 10p.

A computer least squares technique was developed to compute values of the activation energy, Q, the frequency factor, D_0, and their standard deviations by using data obtained from semi-infinite diffusion couples and where Grube's solution of Fick's equation is appropriate. The Gauss iteration method is employed to overcome the problems associated with non-linear functions. A FORTRAN code is available to compute the results. However, initial estimates are necessary. Methods of finding the initial estimates are given. (auth)

32142 (LADC-5868) SOME EXPERIMENTS TO DETERMINE THE SELF-DIFFUSION COEFFICIENT OF PLUTONIUM IN THE DELTA-PHASE REGION. R. E. Tate and E. M. Cramer (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 21p.

The diffusion coefficient for self-diffusion of plutonium in the temperature range 350 to 440°C has been measured by using ^{238}Pu as the tracer isotope. Autoradiographic techniques were used to investigate the possibility of grain boundary diffusion, but only evidence for volume diffusion was found. The least squares fit of the data gives the following equation for the diffusion coefficient: $D = 4.49 \times 10^{-3} \exp [-23{,}765/RT]$ cm²/sec. (auth)

32143 (LADC-5946) THE OSMIUM–IRIDIUM EQUILIBRIUM DIAGRAM. R. D. Reiswig and J. M. Dickinson (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 13p.

The osmium–iridium equilibrium diagram was determined. The diagram is of the simple peritectic type, with a peritectic temperature of about 2660°C. The solid miscibility gap is narrower than previously reported, the nearly vertical solvus lines occurring at about 42 and 63 wt % Os. Widmanstätten figures resembling martensite in some of the two-phase alloys account for a previously suspected transformation. (auth)

32144 (MSAR-64-75) EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 46, June 1964. (MSA Research Corp., Callery, Penna.). July 15, 1964. Contract AT(11-1)-765. 17p.

The effects of air, helium, and sodium contaminated with carbon, hydrogen, and oxygen on the physical properties of type 316 stainless steel and chromium–molybdenum steel are evaluated. The carbon content of the steels saturated with carbon is given. The solubility of hydrogen in sodium is analyzed at high temperatures. (N.W.R.)

32145 (NMI-2813) THE URANIUM–ALUMINUM–IRON CONSTITUTION DIAGRAM. Summary Report. R. B. Russell (Nuclear Metals. Div. of Textron Inc., West Con-

cord, Mass.). June 30, 1964. Contract AT(40-1)-3022. 44p.

Studies were carried out on the high U alloys of Al and Fe using optical and electron metallography, electron microanalysis, and electrical resistance measurements. Solid solubilities were determined for Al, Fe, and Al–Fe in alpha, beta, and gamma U at temperatures ranging from 550 to 1100°C. (D.L.C.)

32146 (RISÖ-77) ELECTRICAL RESISTIVITY, THERMAL CONDUCTIVITY AND THERMO-POWER OF GOLD AT LOW TEMPERATURES. H. H. Andersen and M. Nielsen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Feb. 1964. 22p.

This report describes measurements of the thermal conductivity of gold in the temperature interval 2–18°K and of the electrical conductivity and thermoelectric power of the same material between 2 and 9°K. The primary purpose of these measurements was to investigate the thermoelectric power of gold not containing any of the impurities which give rise to the electrical-resistance minimum and the "giant thermoelectric power." This material was made by neutralizing the responsible impurities by annealing in an oxidizing atmosphere. The thermopower of gold is then shown to be positive above 2.2°K. (auth)

32147 (TID-20758) DI[illegible]ION OF HETEROVALENT SOLUTES IN LIQUID SILVER. R. A. Swalin and V. G. Leak (Minnesota. Univ., Minneapolis. School of Mineral and Metallurgical Engineering). [1964]. Contract [AT(11-1)-841]. 24p.

The diffusion of trace amounts of indium and antimony in liquid silver has been measured in the temperature interval 975 to 1275°C. The diffusion coefficients may be expressed as a function of temperature in the following form. $D_{In} = 5.75 \times 10^{-4} \exp [(-6760/RT)]$ cm^2/sec; and $D_{Sb} = 4.06 \times 10^{-4} \exp [(-5700/RT)]$ cm^2/sec. When compared with the previously determined diffusivities for tin and silver in liquid silver, it is seen that there is a monotonic increase in diffusivity at a given temperature as one increases the relative valence Z of the solute. Thus $D_{Ag} < D_{In} < D_{Sn} < D_{Sb}$ and Z equals 0, +2, +3, and +4, respectively for Ag, In, Sn, and Sb. There also appears to be a monotonic decrease in the activation energy when one considers the series from silver to antimony. This effect is generally the same as found for diffusion of these solutes in solid silver. The relative magnitude of the diffusion enhancement of the solutes is explained quite well by consideration of the added coulomb repulsion of the solute of higher valence in terms of a Thomas–Fermi model if one invokes either the fluctuation model as proposed by one of the authors or the hole theory of diffusion. A fluctuation model which invokes the concept of a critical fluctuation cannot be reconciled with the experiments. (auth)

32148 (UCRL-11317(p.79-130)) MICROSTRUCTURE AND PHYSICAL PROPERTIES. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The deformation of copper, copper alloys, and other materials is summarized along with microstructure and physical properties. (N.W.R.)

32149 (UCRL-11317(p.131-49)) SUPERCONDUCTIVITY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The superconductivity of M_3Al_2C (M = Cr, Mo, Nb, Ta, Ti, or V) compounds is studied with respect to crystal structure and phase studies. The superconductivity of NbC–TaC system is evaluated. The permeability and resistivity of superconductors are experimentally and theoretically analyzed. The effects of composition fluctuations on stress fields of superconductors are investigated. (N.W.R.)

32150 (UCRL-11317(p.150-8)) HIGH-STRENGTH MATERIALS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The formation, crystal structure, phase studies, and mechanical properties of austenitic and martensitic steels are studied. The mechanical properties of iridium are summarized. (N.W.R.)

32151 (UCRL-11317(p.159-64)) KINETICS OF DISLOCATION MECHANISMS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Theoretical and experimental activities relating to the dislocation mechanisms in crystalline materials are summarized. (N.W.R.)

32152 (UCRL-11317(p.165-75)) PHYSICAL CERAMICS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The chemical and physical properties of ceramic materials are summarized. The kinetics of the high-temperature hydrolysis of calcium fluoride and the dehydration of crystalline aluminum hydroxides and aluminum oxide hydroxides are studied. (N.W.R.)

32153 (UCRL-11317(p.176-97)) THERMODYNAMICS AND HIGH-TEMPERATURE REACTIONS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Thermodynamic properties of copper–zinc, bismuth-indium, gallium–antimony, antimony–indium, and iron-manganese alloys are analyzed. The dissociation energy of alkaline earth monohalides is evaluated in the vapor state. The heat of formation of binary alloys is analyzed by the Borelius equation. (N.W.R.)

32154 (WADD-TR-60-37(Pt.IV)) PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN-BASE ALLOYS. Heinz G. Sell, George H. Keith, Randolph H. Schnitzel, and N. Francis Cerulli (Westinghouse Electric Corp. Lamp Div., Bloomfield, N. J.). May 1963. Contract AF33(657)-8247. 103p. (AD-423841)

The strength properties of W–TaC, W–Ta_2O_5, W–ThO_2 and W–C (carburized) alloys were investigated at and below 1650°C. Carbides and oxides stabilize the worked (stress relieved) structure to higher temperatures, and strengthening appears to be due primarily to work hardening. Recrystallized, the alloys, in general, are not stronger than pure tungsten. The tensile properties of single and worked single crystals of W–0.25% Ta were studied from room temperature to 1600°C for a variety of conditions. The combined effect of both alloying and grain boundaries on strength was determined to be about 10,000 psi from 300 to 1600°C. Carburizing, heat treating, and quenching has a large effect on the yield stress of W–0.25% Ta single crystal between 300 and 1000°C. The effectiveness of a pack carburizing technique was evaluated by autoradiography. Also studied was the chemical stability of TaC and ThO_2 in W. TaC decarburizes readily above 2000°C and is easily reduced by WO_3 below 1000°C. ThO_2 is more stable up to 2650°C. (auth)

32155 (WADD-TR-61-72(Vol.XXVI)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXVI. PHYSICAL PROPERTIES OF SOME NEWLY DEVELOPED GRAPHITE GRADES. R. B. Dull (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). Apr. 1964. Contract AF33(616)-6915. 469p.

Measurements were made of the physical properties of the graphites developed and/or evaluated under this program. Methods of and equipment for making these measurements are described. The physical properties are reported for 17 newly developed graphite grades which include six high-density, recrystallized graphites designated as ZT grades; six graphites in which the fillers are shredded or woven carbonized cloths designated as PT grades; and five pressure-cured and/or impregnated grades designated as RVA, RVC, RVD, CFZ, and CFW. Similar properties of ATJ graphite are presented as a basis for comparing the newly developed grades with a well established, premium grade of graphite. (auth)

32156 (JPRS-25069(p.1-31)) ALLOYS ON THE BASE OF THE MAGNESIUM–THORIUM–MANGANESE SYSTEM. Translation of p.133-52 from "Magnievye Splavy Dlya Raboty Pri Provyshennykh Temperaturakh," Moscow, 1964.

Studies were made on the interaction of components in the Mg–Th and Mg–Mn–Th systems, and phase diagrams were constructed. The mechanical properties of deformed Mg–Mn–Th alloys were studied in order to define the limits of the Mn and Th components. The alloying effects of Zr, Ca, La, Ni, Ce, and Nd on the mechanical properties of Mg–Mn–Th alloys were determined. The durability of different alloys is discussed. (D.L.C.)

32157 THE EFFECTS OF SIMULTANEOUS REFLECTIONS ON SINGLE-CRYSTAL NEUTRON DIFFRACTION INTENSITIES. R. M. Moon and C. G. Shull (Massachusetts Inst. of Tech., Cambridge). Acta Cryst., 17: 805-12 (July 10, 1964).

Intensity changes produced in single-crystal diffraction reflections when one or more secondary reflections occur simultaneously are discussed both theoretically and experimentally. The theory is an extension of the usual treatment of secondary extinction, based on the mosaic crystal model. An approximate solution, valid in the thin crystal limit, is in good agreement with neutron diffraction experiments on single crystals of iron. Both theory and experiment demonstrate the importance of sample geometry on the magnitude and sign of the simultaneous reflection effects. The effects may be minimized by controlling the sample geometry in addition to the usual precautions taken to reduce secondary extinction. (auth)

32158 THE SHORT-RANGE STRUCTURE OF COPPER–16 At. % ALUMINUM. Bernard Borie and C. J. Sparks, Jr. (Oak Ridge National Lab., Tenn.). Acta Cryst., 17: 827-35 (July 10, 1964).

The distribution of diffuse x-ray scattering in two planes in reciprocal space for the substitutional solid solution copper–16 at. % aluminum was measured. The symmetry of the distribution showed that there is not only short-range order but as well small static atomic displacements from the expected sites. The short-range order intensity was separated from that associated with the static displacements and the two were treated separately. It was found that the order parameters were satisfactory reproduced by the following model: The Al atoms are distributed on the atomic sites in sets of four so that they occupy the corners of a distorted tetrahedron. The tetrahedra are distributed at random except that no two may be so close that they form an Al–Al nearest neighbor pair. All other sites are occupied by Cu atoms. Measurements after neutron irradiation showed that such exposure caused a small but significant increase in the state of order. (auth)

32159 ON THE CRYSTAL CHEMISTRY OF SALT HYDRATES. II. NEUTRON DIFFRACTION STUDY OF $MgSO_4 \cdot 4H_2O$. Werner H. Bauer (Brookhaven National Lab., Upton, N. Y.). Acta Cryst., 17: 863-9(July 10, 1964).

The crystal structure of $MgSO_4 \cdot 4H_2O$ was refined, single-crystal neutron diffraction data for the three main zones being used. The hydrogen positions that were found were essentially those that were deduced from x-ray data in an earlier investigation (Baur, 1962). The mean values of the O_w-H bond lengths is 0.97 Å. The O_w-H-O bonds are bent considerably. One hydrogen atom does not participate in hydrogen bonding, as can be concluded from the geometry of its surroundings and its thermal motion. (auth)

32160 KIKUCHI PATTERN FROM A SILICON WEDGE. H. A. Fowler (National Bureau of Standards, Washington, D. C.). Acta Cryst., 17: 869-71(July 10, 1964).

Under special conditions of iliumination at 80 kev, the Kikuchi pattern of a thin single-crystal silicon wedge shows a dark cross within the intersection of the 110 and 101 dark zones. The pattern is interpreted as a combination of Bragg reflection effects, acting on the continuum of electrons produced by inelastic scattering. (auth)

32161 THE REFINEMENT OF THE CRYSTAL STRUCTURE OF THE INTERMETALLIC PHASE Al_4Mo. J. A. Leake (Cambridge Univ., Eng.). Acta Cryst., 17: 918-24 (July 10, 1964).

The crystal structure of Al_4Mo was refined by means of two-dimensional difference syntheses using visually estimated x-ray intensity data. The space group is Cm. The unit cell has lattice parameters a = 5.255, b = 17.768, c = 5.225 Å, and $\beta = 100°53'$ and contains 30 atoms arranged in sets of almost close-packed puckered planes. Isomorphism with Al_4W was confirmed. (auth)

32162 REPORT ON THE CRYSTAL STRUCTURE OF Gd_6Mn_{23}. Frederick E. Wang, John V. Gilfrich, Donald W. Ernst, and William M. Hubbard (Naval Ordnance Lab., White Oak, Silver Spring, Md.). Acta Cryst., 17: 931-2 (July 10, 1964).

The crystal structure of Gd_6Mn_{23} was investigated by single-crystal methods. Observation of the regular absence of mixed odd and even Miller indexes and the m3m diffraction symmetry confirmed the crystal structure, face-centered cubic, as previously indicated in the powder pattern. From a zero-layer Weissenberg photograph, which had been calibrated against superimposed NaCl lines (a_0 = 5.6394 A assumed), a lattice constant of a_0 was obtained. The density of the compound was found by the displacement method to be 7.39 g cm^{-3}. Data on the atomic parameters are tabulated. (P.C.H.)

32163 ELASTIC CONSTANTS OF SINGLE CRYSTAL UCd_{11} AT 300°K. M. L. Shepard and J. F. Smith (Ames Lab., Ames, Iowa). Acta Met., 12: 744-5(1964). (IS-736)

Measurements were made of the elastic behavior of UCd_{11} using a sonic pulse-echo technique. The single crystalline bulk modulus was indicated to be 5.75×10^{11} dyne/cm^2. Calculated values agreed with this, indicating that the bulk moduli of intermetallic phases of this type can be reasonably approximated from the bulk moduli of the constituent elements. (M.C.G.)

32164 TRANSMISSION ELECTRON-MICROSCOPIC STUDIES OF TWINNING IN Mo–Re ALLOYS. K. Ogawa (Cambridge Univ., Eng.) and R. Maddin. Acta Met., 12: 713-21(June 1964).

Twins in Mo–35 at. % Re alloys deformed at room temperature and in Mo–18 at. % Re deformed at liquid nitrogen temperature were observed by transmission electron microscopy. Neither extended dislocations nor extended

dislocation nodes were noted. Instead, a dislocation reaction between a slip dislocation and three twinning dislocations was often observed. Direct evidence of the operation of a pole mechanism for twinning was obtained. In view of these observations and of the theory of twinning recently proposed, twinning mechanisms are discussed in detail. The present observations suggest that the critical stage of twinning is the dissociation of slip dislocations in {112} planes into three twinning dislocations. Also direct evidence of the existence of emissary type non-coherent twin boundaries was obtained. The fringe contrast observed in non-coherent twin boundaries in these bcc crystals is interpreted in terms of the kinematical theory of electron diffraction due to stacking faults. A new effect, oscillation of the intensities of electrons diffracted at non-coherent twin boundaries, was found in the region where the absorption effect is prominent and the twinning dislocations are spaced closely. The effect of free surfaces upon the arrangement of dislocations was found to reach as deep as a few hundred Å. (auth)

32165 TWIN-INDUCED GRAIN BOUNDARY CRACKING IN B.C.C. METALS. A. Gilbert, G. T. Hahn, C. N. Reid, and B. A. Wilcox (Battelle Memorial Inst., Columbus, Ohio). Acta Met., 12: 754-5(June 1964).

Evidence is given showing that intercrystalline cracking in Cr, Mo, and W can occur by the intersection of twins with grain boundaries. This was accomplished by straining at room temperature at a strain rate of approximately 10^3/sec in a pneumatic compression impacting machine. The cracks generally propagated a short distance along the grain boundaries and occasionally changed to transcrystalline cleavage. It was concluded that when tension tests are conducted at high strain rates or at low temperatures, twin-induced grain boundary cracking may well be a common mechanism of initiation. (P.C.H.)

32166 MOBILITY OF EDGE DISLOCATIONS OF {110} PLANES IN TUNGSTEN SINGLE CRYSTALS. H. W. Schadler (General Electric Research Lab., Schenectady, N. Y.). Acta Met., 12: 861-70(Aug. 1964).

The mobility of edge dislocation on (110) type planes was measured in single crystals of electron beam-melted tungsten at 298 and 77°K. The stress dependence of the average velocity can be expressed by an equation of the form $\overline{V} = (\tau/\tau_0)^m$ where $\overline{V}$ is the average velocity in cm/sec and τ is the applied shear stress. The value of m was found to increase with decreasing temperature. A limited number of measurements of strain-rate sensitivity of similar specimens indicate that the power dependence of average dislocation velocity on stress, m, can be determined from strain-rate sensitivity measurements only at very low strain. (auth)

32167 MAGNESIUM–COBALT PHASE RELATIONSHIPS AND THE THERMODYNAMICS OF FORMATION OF $MgCo_2$. J. F. Smith and M. J. Smith (Ames Lab., Ames, Iowa). Am. Soc. Metals, Trans. Quart., 57: 337-45(March 1964). (IS-756)

The phase relationships in the magnesium–cobalt binary system were investigated by diffusion, metallography, thermal analysis, and x-ray diffraction. A phase diagram is proposed. The main features of this diagram are a eutectic at 1.9 at.% cobalt and 635°C and peritectic formation of a Laves phase, $MgCo_2$ at 970°C. No other intermediate phases were indicated, and solid solubility was not extensive in either of the components or in the single intermediate phase. Thermodynamic data for the formation of $MgCo_2$ from the pure solid elements were derived from vapor pressure data. The free energy of formation in kcal/g atom is $\Delta F^\circ = -(1.85 \pm 0.50) \pm (0.43 \pm 0.53) \times 10^{-3}\,T$. (auth)

32168 COEFFICIENTS FOR THE DIFFUSION OF LEAD, TIN, AND COPPER INTO SINGLE CRYSTALS OF GOLD IN BOILING 2M HCl. Henry Leidheiser, Jr. Appl. Phys. Letters, 1: 39(1962). (TID-20777(p.8-10))

The phenomenon of intermetallic compound formation during polarization of Au electrodes in boiling 2M HCl containing various metallic ions, was used for the estimation of diffusion coefficients of Pb, Sn, and Cu in Au single crystals. Weight gain data are given for Pb, Sn, and In ions. The diffusion coefficients of Pb and Sn were calculated to be 1.6×10^{-12} and 2.5×10^{-12} cm^2/sec, respectively. No weight change was observed for Cu, in agreement with a diffusion coefficient on the order of 10^{-19} cm^2/sec. (D.L.C.)

32169 DEPENDENCE OF THE TEXTURE OF HARDENED URANIUM ON THE TYPE OF HEATING AND OTHER HEAT-TREATMENT PARAMETERS. V. E. Ivanov, V. F. Zelenskii, A. I. Stukalov, A. V. Azarenko, L. V. Tyrina, Ya. I. Gordienko, and V. V. Kunchenko. At. Energ. (USSR), 16: 325-32(Apr. 1964). (In Russian)

The radiation-induced grain growth of U, as shown by the texture, may be inhibited by quenching from its high-temperature phase. The structure of the metal is affected by the kinetics of the phase transformations; an attempt was therefore made to determine the effect of the heat treatment parameters on the mechanisms participating in the transformations. Specimens subjected to recrystallization at various heating and cooling rates were examined by means of metallographic methods. The results indicated that appearance of a specific texture, its character and its distribution throughout the cross-sectional area, depend greatly on the heating rate and the time period during which the specimen was kept within the range of existence of the high-temperature phase and on the preliminary mechanical treatment of the metal. By a judicious choice of these parameters, it was found possible to affect markedly the degree and even the nature of the texture. The highest degree of quasi-isotropicity, or breakdown of the textured character, was noted on specimens which were kept under tension during the heat treatment; this could be achieved by thermal gradient or by the application of external forces exceeding the yield point of the metal. At low and moderate heating rates the texture of the quenched U depends to a great extent on the method of fabrication and the time of soaking within the range of the β-phase prior to quenching. (TTT)

32170 THE TEXTURE OF HARDENED URANIUM RODS. I. V. Batenin and B. V. Sharov. At. Energ. (USSR), 16: 372-3(Apr. 1964). (In Russian)

The crystalline grain structure observed in hardened U rods is created by the quenching process. This phenomenon was investigated experimentally on 4-mm diameter rods made of technically pure U. It was noted that the textures obtained by deformation and by quenching were quite similar. The hardened texture was examined by x-ray diffraction and by dilatometric techniques. It was found that the same specimen subjected to repeated heat-treatments may become isotropic after annealing or slightly textured by quenching. Slow cooling in air from the β- or γ-phase does not cause formation of such a texture but results in grain growth. The texture may be obtained at the time of the $\beta \rightarrow \alpha$ transformation, even when the γ-phase was quenched; this is due to the large forces

acting as the result of the large volume shrinkage of 1.1% and the large temperature gradients established within the rod. It is possible that martensitic transformation is responsible for the texture of the α-phase after β-quenching in water; however, the direct $\beta \rightarrow \alpha$ transformation appears the most probable cause. (TTT)

32171 THE THERMAL EXPANSION BEHAVIOUR OF PYROLYTIC GRAPHITE-BROMINE RESIDUE COMPOUNDS. W. H. Martin and J. E. Brocklehurst (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Carbon, 1: 133-41(Feb. 1964).

The thermal expansion behavior of pyrolytic graphite-bromine residue compounds, under different applied loads, was examined. The observed behavior is qualitatively explained, using a model that considers the bromine to exist as gaseous bubbles within the lamellar structure of the graphite crystal, and treats these bubbles as Griffith's cracks. The quantitative treatment is not exact and the discrepancies are discussed. A comparison is drawn with the known thermal expansion behavior of some forms of mica. Mica also has a lamellar structure and is known to contain bubbles of the type postulated. (auth)

32172 PLUTONIUM-BEARING GLASS FOR NUCLEAR APPLICATIONS. L. V. Jones. Ceram. Bull., 43: 131-4 (1964).

Silicate glasses were prepared, which contain plutonium oxide as a constituent. Incorporation of the plutonium oxide into a silicate system effectively reduces the hazards normally associated with the handling of plutonium oxide. The plutonium-bearing glasses have possible application as fuels for chemo-nuclear, test, and power reactors. Laboratory size batches were prepared by dissolving up to 20 wt % PuO_2 into parent glass formulations. The plutonium-bearing glass can be formed into various configurations such as fivers, microspheres, and rods. The properties of the glass were investigated by chemical and physical techniques. The plutonium-bearing glasses are used for standard alpha sources because of their contamination-free nature and chemical durability. Fluoride glasses containing PuF_4 produce neutrons by the (α,n) reaction and are used as low-level neutron sources. (Atomdokumentation Vol. 6, Apr. 1964)

32173 QUANTITATIVE STUDY OF THE TEXTURES IN URANIUM FRITTED BY EXTRUSION. Jose Peix and Georges Cizeron (CEN, Saclay and Ecole des Mines, Paris). Compt. Rend., 258: 5435-8(June 1, 1964). (In French)

The respective part of each of the two components of preferential structure developed inside a uranium-base material was evaluated quantitatively by recording the pole figures using the Schulz reflection method and by dilatometric tests. It was possible to determine the preponderant role of one of these structure components in the behavior of the material in the α-phase thermal cycling. (tr-auth)

32174 STRUCTURE STUDY BY THE NEUTRON DIFFRACTION METHOD IN A FAST PULSE REACTOR. V. V. Nitts, Z. G. Papulova, I. Sosnovskaya, and E. Sosnovskii (Joint Inst. of Nuclear Investigations, Dubna, USSR). Fiz. Tverd. Tela, 6: 1369-74(May 1964).

The possibility of conducting neutron structure investigations in a fast pulse reactor (IBR) with an average power of 1 kwt was investigated. A white falling beam was used; the energy scattering spectrum at a given neutron angle was measured according to time-of-flight. The method is distinguished by considerable intensity and low background. The obtained neutronograms of powdered Zn, Al, and ZnO samples offered the possibility of conducting structural analysis of the samples with excellent accuracy. From measurements, the oxygen parameter of ZnO is found to be x = 0.374. (OTS)

32175 EFFECTS OF VACUUM SINTERING ATMOSPHERE ON THE PROPERTIES OF SINTERED UO_2 PELLETS. Tadashi Ogura, Itsuo Kawasaki, et al. (Mitsubishi Atomic Power Ind., Inc., Japan). Funtai Oyobi Funmatsuyakin, 10: 248-56(Dec. 1963). (In Japanese)

Changes of such properties of UO_2 compacts as density, porosity, weight, O/U ratio, and average grain size with increasing sintering temperature were determined for three different kinds of UO_2 powder. Sintering atmospheres of hydrogen, vacuum, and several combinations of these were compared. Conditions of compacting, sintering time, and heating and cooling rates were constant throughout the experiment. In the intermediate stage of sintering, it was revealed that the temperature range in which the pronounced progress of densification occurred was 200 to 300°C lower and that more marked grain growth was encountered in vacuum than in hydrogen. It is suggested that in hydrogen atmosphere, the finer the particle size of the powder, the higher the surface energy, and thus the easier the sintering. In vacuum, the relation is similar so far as the particle size of the powder is concerned. Furthermore, it was concluded that the retention of higher excess oxygen content to a temperature higher than 1,000°C, the activation of the surface layer of the powder by the low pressure, and the cleaning of the powder surface by the desorption of adsorbed gas could be the main mechanisms of acceleration of sintering in vacuum. In the last stage of sintering, however, more closed pores were inclined to appear in vacuum than in hydrogen, which inhibited the grain growth, and the weight loss by mass evaporation became remarkable. (auth)

32176 DISTORTIONS OF THE CRYSTAL STRUCTURE OF Mo AND THE Mo–Re ALLOY DURING DEFORMATION. A. A. Babareko, Tsu-Ts'ung T'ao, and E. M. Savitskii. Izv. Akad. Nauk. SSSR, Met. i Gorn. Delo, No. 1, 176-9 (1964).

Processes occurring during the deformation of Mo of varying degrees of purity and of an Mo alloy with 35 at. % Re were studied to clarify the physical characteristics of the effect of alloying and purification on ductility. Structural distortion was evaluated in relation to the expansion of x-ray interference peaks for metals undergoing deformation. Test specimens were in the form of powders obtained by filling ingots of technical Mo, high-purity Mo, and Mo + 35 at. % Re and were screened through a 300-mesh screen. Interference peaks were automatically recorded. The width of the lines at 110, 200, 112, 220, 310, 222, and 321 mμ was measured 5 times. It was found that the high ductility of pure Mo leads to a decrease in the dimensions of coherent scattering regions and lower microdeformation as compared to technical Mo (8×10^{-6} to 2.5×10^{-6} cm and 0.0038 to 0.0025, respectively) due to greater depth of plastic deformation in pure Mo during the filling of the powders. Minor anisotropy of elastic properties of Mo resulted in a microdeformation-related anisotropic widening of the diffraction lines. Such anisotropy was absent for the Mo–Re system. (A.I.D. Press)

32177 MOLAR VOLUME AND SURFACE TENSION OF FUSED METAPHOSPHATE–SULFATE SYSTEMS. B. B. Owens and S. W. Mayer (Atomics International, Canoga Park, Calif.). J. Am. Ceram. Soc., 47: 347-51(July 21, 1964).

The molar volume and surface tension of the $NaPO_3$–Li_2SO_4, $NaPO_3$–Na_2SO_4, $NaPO_3$–Rb_2SO_4, and $NaPO_3$–UO_2SO_4 solutions were determined for the $NaPO_3$-rich region. The observed properties were found to vary linearly with temperature in all cases. Although the results of other types of investigations were found to be nonideal, the volume behavior of all the mixtures was additive. (P.C.H.)

32178 HIGH-TEMPERATURE THERMAL EXPANSION BEHAVIOR OF REFRACTORY MATERIALS. I. SELECTED MONOCARBIDES AND BINARY CARBIDES. Bruno R. Miccioli and Peter T. B. Shaffer (Carborundum Co., Niagara Falls, N. Y.). J. Am. Ceram. Soc., 47: 351-6(July 21, 1964).

An apparatus for absolute thermal expansion measurements was developed and operated to 2843°C. Thermal expansion characteristics were measured for niobium carbide, zirconium carbide, tantalum carbide, and the carbide solutions 8TaC · ZrC, 4TaC · ZrC, TaC · ZrC, and TaC · 4ZrC. Supporting evidence for a high temperature inversion in the monocarbides of zirconium and tantalum was observed. Evidence of analogous behavior for other carbides is also reported. (auth)

32179 THERMAL DECOMPOSITION OF CEROUS OXALATE AND VARIATION OF SURFACE AREA OF THE PRODUCTS. V. V. Subba Rao, R. V. G. Rao, and A. B. Biswas (National Chemical Lab., Poona, India). J. Am. Ceram. Soc., 47: 356-60(July 21, 1964).

The thermal decomposition of hydrated cerous oxalate was studied in the temperature range 30 to 1000°C by measuring the surface area of the products and mass change at various stages. The products were characterized by infrared absorption and x-ray diffraction analyses. Two peaks in the surface area vs temperature curve were observed. The first peak was due to the decomposition of the oxalate, which caused an increase in surface area, followed by partial crystallization of the oxide, which reduced the surface area. The increase in surface area in the region 440 to 650°C was attributed to the decomposition of the carbonaceous materials dispersed in the oxide matrix; it was followed by a decrease in area due to bulk sintering of the oxide. (auth)

32180 TRIVALENT RARE-EARTH TUNGSTATES OF THE TYPE $M_2(WO_4)_3$. K. Nassau, H. J. Levinstein, and G. M. Loiacono (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Am. Ceram. Soc., 47: 363-4(July 21, 1964).

An investigation on the structure of trivalent rare earth tungstates of the type $M_2(WO_4)_3$ showed that phase transitions were the rule rather than the exception, that the ionic radius was a controlling factor in the structural considerations, and that at least four structural types occurred. An outline of the occurrence of the various structures is given. Existence of the phases was determined by x-ray diffraction work on quenched and annealed sintered specimens in conjunction with single-crystal pulling experiments and differential thermal analysis work. Several unusual characteristics were observed. The changes in structure appeared to be related only to the ionic radius and the temperature. (P.C.H.)

32181 PARAMAGNETIC SUSCEPTIBILITY, ELECTRICAL RESISTIVITY, AND LATTICE PARAMETERS OF NICKEL-RICH NICKEL–TANTALUM ALLOYS. Henry Chessin, Sigurds Arajs, and R. V. Colvin (United States Steel Corp., Monroeville, Penna.). J. Appl. Phys., 35: 2419-23(Aug. 1964).

The paramagnetic susceptibility, electric resistivity, and lattice parameters of nickel-rich nickel–tantalum solid solutions (10 compositions) were studied. The paramagnetic measurements extend to about 1500°K. The resistivities were obtained at 4.2, 77.2, and 297.0°K. The lattice parameters of samples quenched from 1473°K were determined at 298°K. All these data indicate that the influence of tantalum on the physical properties of nickel is very similar to that of niobium. It is demonstrated by means of the magnetic susceptibility measurements that the generally accepted Curie-Weiss law, with an additive temperature-independent susceptibility term, is not applicable to the solid solutions of tantalum in nickel. The susceptibility and resistivity data are briefly discussed from the viewpoint of recent theoretical and experimental developments. The lattice parameters are analyzed using the previously suggested atomic volume scheme and elasticity theory. The agreement between the experimental values and the predictions is satisfactory. (auth)

32182 THERMOELECTRIC PROPERTIES OF URANIUM MONOSULFIDE, THORIUM MONOSULFIDE, AND US–ThS SOLID SOLUTIONS. Marvin Tetenbaum (Argonne National Lab., Ill.). J. Appl. Phys., 35: 2468-72(Aug. 1964).

The measurements on the temperature dependency of the Seebeck coefficient and resistivity of sintered specimens of uranium monosulfide, thorium monosulfide, and US–ThS solid solutions indicate semimetallic and metallic behavior for US and ThS, respectively. The thermoelectric power of US exhibits a weak dependence on temperature and decreases with increasing ThS content; except for initial disordering effects, the resistivity of US shows a similar dependence on temperature and composition. The presence of higher sulfides in US results in a considerable lowering of the Seebeck coefficient with increasing temperature. The figures of merit for US are too low for useful high-temperature power generation by a factor of approximately ten. (auth)

32183 EQUILIBRIUM DIAGRAM OF THE SYSTEM Nb_2O_5–WO_3. Leon J. Fiegel, Ganesh P. Mohanty, and James H. Healy (A. O. Smith Corp., Milwaukee). J. Chem. Eng. Data, 9: 365-9(July 1964).

An equilibrium diagram of the Nb_2O_5–WO_3 system is presented. The existence of two compounds, Nb_2O_5–WO_3 and $Nb_2O_5 \cdot 3WO_3$, was postulated. The work of Kovba and Trunov on $Nb_2O_5 \cdot 3WO_3$ (a, b = 12.190Å, c = 3.934Å) was verified. Experimental procedures included room temperature x-ray diffraction of previously annealed samples, high-temperature x-ray diffraction, and differential thermal analysis. Some work was also done on the low-temperature transformation of WO_3 and WO_3–Nb_2O_5 compounds. (auth)

32184 THE TEMPERATURE-DEPENDENCE OF YIELD AND BRITTLE-FRACTURE STRESSES IN POLYCRYSTALLINE MOLYBDENUM. Andrew Wronski (Imperial Coll. of Science and Tech., London). J. Inst. Metals, 92: 376-7 (July 1964).

Studies showed that the values for yield stress, σY, and brittle-fracture stress, σF, at 295, 195, 77, and 20°K for fine-grain and coarse-grain molybdenum were $l^{-\frac{1}{2}} \approx 6.1\ mm^{-\frac{1}{2}}$ and $l^{-\frac{1}{2}} \approx 2.9\ mm^{-\frac{1}{2}}$, respectively. It was clear that σF continues to vary with temperature in much the same way as σY. It thus appears that for arc-cast Mo also the brittle-fracture stress increases sharply with decreasing temperature and is equal to the yield stress in compression. Reasons for this are discussed. (P.C.H.)

32185 AN INVESTIGATION OF THE MAGNESIUM–ZIRCONIUM SYSTEM. I. M. Vesey and H. J. Bray (Univ. of Manchester, Eng.). J. Inst. Metals, 92: 383-4(July 1964).

A study was made of the magnesium-rich end of the Mg–Zr diagram by means of detailed thermal, microscopical, microhardness, x-ray diffraction, and scanning electron-probe microanalyzer techniques. The diagram was found to be of the form developed previously by others. The intersection of the two portions of the liquidus, that determined by thermal analysis and that determined by suction sampling, gave the position of the peritectic point, which was thus found to be at 653.6 ± 0.5°C and 0.6 ± 0.04 wt % Zr. Solid/solid diffusion-couple specimens after heat treatment at 645°C for 800 hr showed no microscopical evidence of a diffusion zone in Zr, either in the form of an intermetallic layer or of a Zr-rich solid solution; however, etching for Mg in the couple with phospho-picral etchant revealed a layer of a solid solution of Zr in Mg. Examination of liquid/solid diffusion-couple specimens, heat-treated at 800°C for up to 600 hr, showed that the Mg had attacked the Zr intergranularly. Microhardness tests on the couples indicated an increase in hardness both in the Mg-rich solid solution and the Ar as the boundary between the two was approached, but the increase was not of an order that would indicate anything other than solid-solution formation. (P.C.H.)

32186 SLIP-INDUCED CLEAVAGE IN POLYCRYSTALLINE TUNGSTEN. A. Wronski and A. Fourdeux (Union Carbide European Research Associates, Brussels). J. Less-Common Metals, 6: 413-29(June 1964).

Fracture of polycrystalline tungsten was studied by two methods: by investigating the tensile properties of bulk material in the temperature range 77 to 490°K and directly by stretching thin foils inside the electron microscope. The ductile-brittle transition temperature was found to be ~350°K at a stress level of ~40 kg • mm^{-2} and the brittle fracture stress was found to increase markedly with decreasing test temperature. In the temperature range 140 to 490°K the metal failed in tension by slip-induced cleavage, while at 77°K twinning occurred and was probably responsible for fracture. During the deformation of thin foils inside the electron microscope dislocations were found to nucleate within the grains and move in both the {110} and the {112} planes. The dislocations generally did not "pile-up" against the grain boundaries but formed arrays of a different configuration. Microcracks were seen to be nucleated within these dense dislocation arrays in the {110} planes only. They propagated in these planes to the grain boundaries and then continued in transcrystalline and/or intergranular fashion. A possible interpretation of the results is given in terms of the observed distribution of dislocations. The measured stresses for bulk material in the region of the ductile-brittle transition and the calculated stresses for thin foils, were within 50% of each other. (auth)

32187 THE EFFECT OF ANNEALING TEMPERATURE ON THE DUCTILITY AND FRACTURE OF URANIUM. D. M. R. Taplin and J. W. Martin (Oxford Univ.). J. Less-Common Metals, 6: 430-3(June 1964).

Commercial purity uranium (total impurities <500 ppm) was subjected to a rolling and annealing schedule to produce a fine uniform grain structure. Samples were rolled 28% at 300°C and annealed for 24 hr at a range of temperatures between 240 and 750°C and tensile tested. The tensile properties together with hardness measurements, were correlated with the metallography of fracture. A hypothesis for the two ductility peaks is presented in terms of the change in fracture characteristics. (auth)

32188 OBSERVATIONS ON DISLOCATIONS WITH BURGERS VECTORS OTHER THAN [100] AND ½ ⟨110⟩ IN α-URANIUM. C. M. Van Der Walt and M. J. Makin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 6: 434-8(June 1964).

Electron microscopy was used to obtain information about the direction of Burgers vectors in α-uranium. It was concluded that at least two families of dislocations with Burgers vectors out of the (001) plane do commonly exist in α-uranium, probably in the dissociated form. (M.C.G.)

32189 THE EFFECT OF LOW PERCENTAGE ALLOYING ADDITIONS OF THE DUCTILITY OF IODIDE CHROMIUM. O. N. Carlson, L. L. Sherwood, and F. A. Schmidt (Ames Lab., Ames, Iowa). J. Less-Common Metals, 6: 439-50(June 1964). (IS-693)

The ductility of binary chromium-base alloys containing 0.1, 0.5, 1.5, and 3.0 wt % of 34 different metals was evaluated from bend tests on arc-melted specimens. The results of this investigation indicated that the brittle-ductile transition temperature of chromium-base alloys is dependent primarily on the atomic size of the alloying addition. The transition temperature of iodide chromium was decreased by the addition of solute atoms that formed solid solution alloys and had atomic diameters larger than chromium but not exceeding the 15% size limit. Those elements with atomic diameters between 2 and 10% larger produced the maximum decrease in the brittle-ductile transition temperature. Those alloying additions that exhibited little or no solid solubility in chromium and had atomic diameters that exceed the 15% limit all raised the transition temperature of high-purity chromium. Additions of those metals that form carbides, nitrides, and oxides that were more stable than the corresponding chromium compounds increased the brittle-ductile transition temperature rather sharply, which is the converse of what was previously observed on chromium of lower purity. (auth)

32190 RELATIONS BETWEEN THE STRUCTURES OF PHASES IN THE SYSTEM PLATINUM–MOLYBDENUM. H. P. Rooksby and B. Lewis (General Electric Co. Ltd., Wembley, Eng.). J. Less-Common Metals, 6: 451-60 (June 1964).

A study was made of crystal structure changes effected by heat treatment of platinum-coated molybdenum wire. At temperatures above about 800°C, solid diffusion of molybdenum into the platinum occurred. This caused alterations in the atomic arrangement, and as the Mo-content increased, four intermediate alloy phases developed in succession. These are denoted by the symbols β, γ, δ, and ε. β-Pt_3Mo has a face-centered tetragonal structure, γ-Pt_2Mo is orthorhombic pseudo-hexagonal, the δ phase ranging in composition from Pt_3Mo_2 to at least $PtMo_2$ has an ordered A3 type hexagonal structure, while ε-$PtMo_3$ has the cubic A15 type structure. Through the sequence of structure transitions, the pivotal feature appeared to be the persistence of the more or less close-packed layers of atoms. The spacing of these planes in the various structures altered only slightly throughout the series, although the composition changes were considerable. The relationship between the five structures, including that of pure platinum, appeared to be very close, so that transitions occurred with the minimum of atomic movement and alteration of lattice spacings. The phases were thus almost akin to a sequence of discrete but ordered solid solutions. Structure data and planar spacing lists for the four intermediate phases, compiled from their x-ray patterns, are given. (auth)

32191 THE THERMAL EXPANSION OF POLYCRYSTALLINE CARBON AND GRAPHITE FROM –196°C TO 2000°C. I. B. Mason and R. H. Knibbs (Atomic Energy Re-

search Establishment, Harwell, Berks, Eng.). J. Nucl. Energy, Pts. A & B, 18: 311-39(June 1964).

The thermal expansion of artificial graphite is of particular interest to designers of high-temperature graphite-moderated reactors since it correlates with the dimensional changes that occur under fast neutron irradiation. Measurements were made of the thermal expansion coefficients of a number of different artificial polycrystalline graphites over the temperature range −196 to 2000°C. It is shown that, above room temperature, the thermal expansion coefficients of all the graphites measured rise linearly with temperature. An analysis of the results, made in terms of the single-crystal expansion, indicates that changes in artefact structure above 800°C correspond with analogous changes resulting from neutron irradiation. (auth)

32192 SOME STUDIES ON MAGNOX A-12 SUBJECT TO RESTRICTED DEFORMATION CAUSED BY URANIUM. Masanobu Sasagawa, Akira Usui, et al. (Japan Atomic Energy Research Inst., Tokyo). J. Soc. Mater. Sci., Japan, 13: 210-15(Mar. 1964). (In Japanese)

The sheath and core materials bonded together to form fuel elements generally function under different conditions of temperature and atmosphere. When the rigidity of the sheath material is poorer than that of the core material, the sheath is subject to deformation to match the core under service. Hence, it seems important to clarify such relative deformation considering the thermal fatigue behavior from the view point of the design, safety, and usage of the fuel element. In our research "the universal thermal fatigue testing machine" originally designed to investigate relative deformation and other various thermal fatigue phenomena in general was used. The experimental procedures were carried out with uranium and Magnox A-12 in separated positions. The difference in thermal strain that occurred from the difference in thermal cycling temperature ranges was accurately transmitted to Magnox A-12, and its induced stress behavior, microstructure, and failure were observed. When Magnox A-12 is restricted by uranium, ompressive stress in Magnox occurs at a higher temperature range, and the stress is very small in spite of the sudden increase in elongation brought about by heating uranium above its transformation temperature. This fact shows that the deformation of Magnox advances by creep. The increase of the cycling period from 0.5 to 4 hr per cycle promotes tensile creep and stress relaxation at a lower temperature range. The maximum stress induced in Magnox under the restricted relative deformation caused by thermal cycling of 190−575°C for uranium and 150−450°C for Magnox is higher even after 320 cycles than that of the original state. These results show that Magnox is easily subject to the deformation of uranium and that the Magnox load on uranium is very small. The difference in stress and strain values between tension and compression sides during the thermal fatigue test increases with the lowering of the thermal cycling temperature. Visible basal slips and twins occur after one cycle, and the position of deformation moves toward the grain boundary from the grain interior with the increase of both cyclic number and cyclic temperature range. In the case of a higher thermal cycling temperature range, such as 275−475°C, the grain growth and the grain boundary flow become remarkable, resulting in wrinkles on the surface. The occurrence of wrinkles influences the heat transfer from the core. During the whole experiment, cavitation discovered in ordinary creep tests could not be found. This fact seems to depend upon the difference of loading direction between the creep tests and these experiments. Some peculiarities of the above mentioned behaviors and some problems in Magnox A-12 used for sheath material are discussed also from the crystallographic anisotropic point of view. (auth)

32193 THERMAL EXPANSION OF PYROLYTIC GRAPHITE AND ITS VARIATION DUE TO NON-ALIGNMENT OF THE CRYSTALLITES. R. H. Knibbs and I. B. Mason (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 203: 58-60(July 4, 1964).

It is shown that the thermal expansion coefficient of pyrolytic graphite depends markedly on the degree of crystallite alignment, and that the coefficient can be estimated from a knowledge of the degree of alignment and the graphite lattice expansion coefficient. (C.E.S.)

32194 EFFECT OF THE CARBON CONTENT ON PROPERTIES OF WC−10% Co ALLOY. Hisashi Suzuki, Masataka Sugiyama, and Takateru Umeda (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 28: 55-8(1964). (In Japanese)

WC-10% Co alloys with various contents of carbon were prepared by the addition of sugar carbon to as-received WC powder and subsequent ball-milling and vacuum-sintering at 1370 to 1450°C for 1 hr followed by furnace cooling. The effect of the carbon content on the properties of the alloys such as hardness, transverse rupture strength, density, grain size, electrical resistivity and its coefficient, lattice constant of binder phase, relative magnetic saturation, coercive force, and microstructrue were studied. All properties of the alloy varied characteristically with carbon content. The strength of the alloy became a maximum, when the carbon content of the alloy in the two-phase range attained approximately a maximum (when at 6.15 to 6.18 wt % C it was larger than the theoretical carbon content of WC). Under this condition, for example, lattice constant of the binder and the electrical resistivity was at its minimum. The narrow two-phase range corresponded to the width of about 0.15 to 0.18 wt % C, which was wider than that induced from the result by J. Gurland. The carbon content in cemented carbides was found to be successfully controlled by adding free carbon to the powder. (auth)

32195 ON THE TEMPER HARDENING PROPERTIES OF Co−W ALLOYS. Tadatoshi Toda (Hitachi, Ltd., Tokyo). Nippon Kinzoku Gakkaishi, 28: 72-8(1964). (In Japanese)

Rods of Co−W (0 to 25%) alloys were made by sintering and hot swaging. Dilation behaviors through the $\alpha \rightleftharpoons B$ transformation and x-ray diffraction analyses of quenched or tempered specimens were examined for these alloys. The temper hardening and the T.T.T. (time-transition-temperature) diagram of the β-to-α transformation were measured in detail for Co−25% W alloys. The crystal structure of Co−25% W alloy quenched from 1100°C had the fcc lattice of β-phase. Upon tempering of the quenched specimen at 600 to 675°C, the β-phase transformed slowly into the hcp lattice of α-phase accompanying an increase in hardness. The rate of the transformation was apparently controlled by diffusion. The maximum Vicker's hardness value, 750, was attainable by optimum conditions of the tempering. The T.T.T. diagram of the β-to-α transformation was determined in Co−25% W alloy by the metallographic method. The nose of the T.T.T. diagram was placed at about 750°C, where the beginning or the ending time of the transformation was equal to about 700 sec or 10,000 sec, respectively. (auth)

32196 CRYSTALLOGRAPHIC STUDY OF α-Pu AND δ-Pu AT LOW TEMPERATURES. P. Solente (CEN, Fontenay-aux-Roses, France). Phys. Letters, 10: 266-7 (June 15, 1964). (In French)

A crystallographic study of two allotropic varieties of Pu—α and δ—was undertaken between 12 and 300°K. Analysis of the diffraction of the tungsten 531 Lα ray by samples of Pu, Pu–Al 5%, and Pu–Al 8% showed a dilation anomaly between 80 and 120°K, an intensity anomaly for Pu–Al 5% at the same temperatures, and a dependence of the diffraction ray profile on the time spent at low temperature. Debye temperatures for these two alloys calculated from a measure of the intensity variation with temperature disagree with values found from the room-temperature speed of sound in the alloys. The diffraction spectrum of α-Pu showed no negative coefficient of dilation below 50°K, disagreeing with previous measurements. Anomalies in δ-Pu do not disagree with a possible magnetic transition. The variation of the ray profile with time at low temperature may be attributed to an autoirradiation phenomenon. (M.J.T.)

32197 INTERPRETATION OF MÖSSBAUER EFFECT MEASUREMENTS ON THE MAGNETISM OF DILUTE ALLOYS. R. M. Housley and J. G. Dash (Univ. of Washington, Seattle). Phys. Letters, 10: 270-1(June 15, 1964).

An explanation of Mössbauer effect measurements on the magnetism of dilute Fe in Cu is offered in terms of a coupling between localized moments of the Fe atoms and spin density waves in the conduction electrons of the host. (L.B.S.)

32198 INVESTIGATION OF THERMAL EXPANSION OF TUNGSTEN, MOLYBDENUM, TANTALUM, NIOBIUM, AND ZIRCONIUM AT HIGH TEMPERATURES. V. M. Amonenko, P. N. Vyugov, and V. S. Gumenyuk. Teplofiz. Vysokikh Temp., No. 1, 29-31(1964).

The relative elongation of the metals was measured with an improved contact-making vacuum dilatometer used in conjunction with an optical pyrometer (800 to 2000°C range) or a Pt–PtRh thermocouple (200 to 1200°C). The length measurements were accurate to ±1μ (1% at high and 3% at low temperatures), and the temperature was uniform within 5°C. A tungsten resistance furnace was used to heat the tested metals (zirconium to 1450°C and the others to 2000°C). Empirical formulas were derived to fit the temperature vs relative elongation curves obtained, differentiation of which yielded the temperature variation of the linear expansion coefficients. The kink in the curve for zirconium (beginning with 865°C) was due to its allotropic transformation. (OTS)

32199 A MATRIX REINFORCED THERMAL PROTECTIVE SYSTEM. S. Rovin (Lockheed Missiles and Space Co., Sunnyvale, Calif.), T. A. Greening, and F. Adgate. Welding J. (N. Y.), 43: 329s-36s(July 1964).

Refractory metals such as W and Nb and some of their alloys were investigated after their selection as a result of a screening evaluation made to determine materials that could best be drawn into wire, woven into a grid-matrix, and subsequently resistance welded to a refractory-metal substrate. The work performed is oriented toward the researching of thermal protective systems for manned vehicular systems capable of operating in a temperature regime greater than 3000°F but less than 6500°F for sustained periods of time, with possible lifetimes of five flights. It is necessary that the hot wall structure be of light-to-medium density range (7 to 12 lb/ft^2 of surface area) with relative ease of attachment, repair, and replacement. The temperature gradient from T_w outer to T_w inner is calculated to be on the order of 4 : 1. (auth)

32200 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM BORIDES CONTAINING IRON-GROUP METALS. V. F. Funke and S. I. Yudkovskii (All-Union Inst. of Hard Metals, Academy of Sciences, USSR). Zh. Fiz. Khim., 38: 1280-3(May 1964). (In Russian)

The oxidation kinetics of the systems ZrB_2–Fe, ZrB_2–Co, and ZrB_2–Ni were studied at 500 to 1000°C. The rate of oxidation varied with the amount of metal added and the temperature; the higher the temperature and the content of Ni, Fe, and Co the more rapid the oxidation and the more oxide coating appeared on the surface. The rate of oxidation at 500 to 1000°C was identical for ZrB_2 alloyed with 12 to 14% Fe, Ni, or Co. The stability of systems with zirconium boride base is about 2 to 3 times higher than the stability of systems of titanium boride. (R.V.J.)

32201 EFFECTS OF LANTHANUM AND ZIRCONIUM ON THE RESISTANCE OF SILICATE GLASS TO ALKALI. V. S. Molchanov and T. M. Makarova. Zh. Prikl. Khim., 37: 886-7(Apr. 1964). (In Russian)

An analysis of the effects of La and Zr on the resistance of silicate glass to caustic soda showed that at a caustic soda concentration up to 2N, lanthanum oxide improves the stability of silicate glass better than zirconium dioxide. In concentrated caustic soda, in carbonate solutions, and in mixed alkali and carbonate solutions the lanthanum glass disintegrates faster than in dilute caustic soda, and is much weaker than the zirconium glass. (R.V.J.)

32202 ABSORPTION CENTERS IN γ-IRRADIATED GLASS OF Na_2O–ZnO–SiO_2 SYSTEM. V. V. Vargin and S. A. Stepanov. Zh. Prikl. Khim., 37: 1366-8(June 1964). (In Russian)

Experiments with glass containing 10 to 40% Na_2O, 0 to 35% ZnO, and 45 to 80% SiO_2 and irradiated by 5×10^6 r indicated the presence of a 4.6-ev absorption band produced by $^{2+}$Zn ions. The presence of ZnO acts as a damping factor on the 2- and 2.8-ev bands. An equilibrium was observed between $^{2+}$Zn ions in the quaternary and sextuple coordination in all Na_2O–ZnO–SiO_2 systems with an arbitrary amount of ZnO. The abnormal influence of ZnO on the absorption band in a glass with 35% Na_2O is explained by the presence of a Si atom with two unbridged oxygen atoms. (R.V.J.)

32203 STRUCTURAL AND PHYSICAL PROPERTIES OF ALLOYS AND INTERMETALLIC COMPOUNDS. Karl A. Gschneidner, Jr. (Los Alamos Scientific Lab., N. Mex.). p.222-58 of "Progress in the Science and Technology of the Rare Earths. Vol. 1." Oxford, Pergamon Press, 1964. (LADC-4898)

Information published mainly in 1960 on rare earth alloys and intermetallic compounds is reviewed. Phase diagrams of intra-rare earth systems and of binary systems are discussed. Lattice spacings of solid solution alloys, intermetallic compounds, thermal expansion, electric resistivity, Hall effect, magnetic properties, mechanical properties, melting and transformation points, nuclear magnetic resonance, oxidation and corrosion, superconductivity, thermal conductivity, thermodynamic properties, thermoelectric properties, vapor pressure, and some other properties are also treated. (146 references). (M.C.G.)

32204 PLUTONIUM METAL. W. H. Zachariasen (Univ. of Chicago). p.185-94 of "The Law of Mass Action. A Centenary Volume, 1864-1964." Oslo, Det Norske Videnskaps-Akademi, 1964.

Studies of the crystal structure of plutonium are discussed. The metallic radius of plutonium and related elements and the interrelationship between metallic radius and electron structure are considered. The three high-temperature phases of plutonium were found to have simple structures typical of metals. Complex monoclinic and

orthorhombic structures were found for the three low-temperature phases. (M.C.G.)

32205 SELECTED VALUES OF THERMODYNAMIC PROPERTIES OF METALS AND ALLOYS. Ralph Hultgren, Raymond L. Orr, Philip D. Anderson, and Kenneth K. Kelley. Wiley Series on the Science and Technology of Materials. New York, John Wiley & Sons, Inc., 1963. 972p. $12.50.

Reliable thermodynamic data for metallic elements and binary alloy systems are presented in easy-to-use tabular form. The data were all tested for consistency with thermodynamic laws, with the phase diagram, and with other published material. For each alloy system the results of the survey are briefly discussed. Information is included on methods of evaluation, properties of metallic elements, and properties of binary alloys. Systems and authors are indexed separately. (P.C.H.)

32206 VAPORIZATION OF TANTALUM CARBIDE–HAFNIUM CARBIDE SOLID SOLUTIONS AT 2500° TO 3000°K. D. L. Deadmore (Lewis Research Center, Cleveland). 29p. (CONF-553-5)

From American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

The vaporization rates in vacuum of hot-pressed HfC, TaC, and solid solutions of these two carbides in the temperature range of 2500 to 3000°K were determined by a Langmuir type method. The results show that a composition near 70 mole percent TaC · 30 mole percent HfC exhibits the lowest vaporization rate of any composition within this pseudobinary system. Variations in initial sample bulk density and vapor-specie condensation on the furnace wall have negligible effects on the measured vaporization rates. Preliminary information concerning the influence of time on the vaporization rate of selected compositions is discussed. (auth)

32207 TRANSVERSE STRENGTH OF PRESTRESSED BERYLLIA AT ELEVATED TEMPERATURE. Charles Kallup and Stanley V. Castner (Marquardt Corp., Van Nuys, Calif.). 12p. (CONF-553-3)

From American Ceramic Society 66th Annual Meeting, Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

Transverse rupture strength was determined for hot-pressed beryllium oxide bars over the temperature range of 1000 to 2500°F. Optimum compressive prestress values were determined for four temperature levels. Test results indicated that precompressed beryllium oxide can support loads more than double the loads that can be supported by nonstressed beryllium oxide. (auth)

32208 VALENCE BONDING IN ALLOYS HAVING THE β–TUNGSTEN STRUCTURE. F. L. Carter (Westinghouse Research Labs., Pittsburgh). 69p. (CONF-524-13)

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

Bond formation between atoms in metallic compounds with the β-tungsten structure (A_3B) is discussed in terms of the simple concepts of valence bonding in conjunction with the coordination and distances of near neighbors. The most pronounced feature of the structure is the short distances in infinite linear chains of A atoms. These distances indicate that the bonds within the chains are composed of a single bond plus a certain fraction of a π-bond as in the C=C double bond. By linking the phases of contiguous π-bonds, three-dimensional phase structures may be formed. The superconducting properties are associated with the existence of the linear chains and the phase structures. (auth)

32209 URANIUM DIOXIDE FUELS. Bernhardt Weidenbaum, Sherman Naymark, and Thomas J. Pashos (General Electric Co., San Jose, Calif.). 15p. (CONF-504-7)

From American Power Conference 26th Annual Meeting, Chicago, Apr. 1964.

Uranium dioxide's chemical and physical characteristics combine with its radiation stability to provide the basis for a long-life fuel. Uranium dioxide is also considered advantageous as a nuclear fuel because of lower fabrication costs, lower costs to process the irradiated fuel, and lower uranium hexafluoride conversion costs associated with its use. Experimental programs in progress indicate that uranium dioxide fuel can be used in the molten state so long as a layer of solid UO_2 is maintained adjacent to the cladding to serve as a container for the molten fuel. Extended operations with cored pellet and vibratory compacted powder fuel rods, with an appreciable fraction of the fuel molten, point the way for operating UO_2 fuel in power reactors at higher power levels than those used at the present time. (auth)

32210 IMPROVEMENTS IN AND RELATING TO REFRACTORY COMPOSITIONS. Clarence Lloyd Babcock and Murray McDavitt (to Owens-Illinois Glass Co.). British Patent 962,568. July 1, 1964. Filed Nov. 11, 1960.

Alumina–silica–dolomitic limestone glasses, which are suitable for use in severe environmental conditions, were found to exhibit the following properties: high electric resistance, low electric losses, good chemical and neutron resistance, and high softening point temperatures. The compositional range and physical properties of the glasses are tabulated. (L.B.S.)

32211 IMPROVEMENTS IN OR RELATING TO MAGNESIUM BASE ALLOYS. Philip Andrew Fisher (to Magnesium Elektron Ltd.). British Patent 963,073. July 8, 1964. Filed Apr. 12, 1962.

It is found that the addition of over 0.05 to 0.25 percent manganese to magnesium base alloys increases the resistance to grain growth on exposure to high temperatures, resulting in an alloy with sufficient ductility for use in canning uranium for nuclear reactor. (L.B.S.)

32212 PLUTONIUM ALLOY AND ITS USE. Claude Cummings Herrick (to U. S. Atomic Energy Commission). German Patent 1,167,037. Apr. 2, 1964. Priority date Apr. 25, 1960, United States.

A plutonium alloy for homogeneous nuclear reactors was developed, which is composed of 8 to 15 at.% iron, cobalt, or nickel, a quantity of carbon which is bigger than the usual contaminations contained in plutonium, e.g., 2 at.%, and the rest plutonium. This alloy is used as liquid fuel in a homogeneous reactor in which the fuel is enclosed by tantalum. The tantalum may be coated with tantalum carbide. (Gmelin Inst.)

32213 PLUTONIUM ALLOY FOR NUCLEAR FUEL. Arthur Shotter Coffinberry (to U. S. Atomic Energy Commission). German Patent 1,167,038. Apr. 2, 1964. Priority date July 17, 1958, United States.

An alloy for a liquid nuclear fuel is given, which is composed of 3 to 96% by weight plutonium, at least 1% by weight cerium, and small quantities of cobalt the composition being within a certain area of the diagram of the Pu–Co–Ce system shown. (Gmelin Inst.)

32214 NICKEL–HAFNIUM ALLOY. Rudolf Reinbach (to Vacuumschmelze AG). German Patent 1,168,649. Apr. 23, 1964. Filed June 29, 1959.

The nickel–hafnium alloy is characterized by a content of 0.1 to 10% hafnium, the rest being nickel. This alloy can be used for goods which require a high temperature of recrystallization and which have good physical properties even at high temperatures. (Gmelin Inst.)

Radiation Effects

32215 (A/CONF.28/P/241) IRRADIATION BEHAVIOR OF FLUID FUELS. W. R. Grimes (Oak Ridge National Lab., Tenn.), E. G. Bohlmann, and L. D. Kirkbride. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The effects of irradiation on various fluid fuels are studied. The examples studied include: aqueous-solution fuels (e.g., uranyl sulfate solution in HRE-2 and a uranium-ion-bearing phosphoric acid solution in LAPRE-II); aqueous-slurry fuels (e.g., ThO_2 slurries, which have been tested in in-pile loops); alkali-metal-slurry fuels (e.g., UO_2 slurries in a Na–K eutectic mixture, which have also been tested in in-pile loops); molten Pu–Fe fuels (as in LAMPRE); molten U–Bi fuels (as in Liquid Metal Fueled Reactor studies at Brookhaven); and molten $^7LiF-BeF_2-UO_4$ mixtures (as in MSRE). (T.F.H.)

32216 (A/CONF.28/P/242) RADIATION-INDUCED CHANGES IN THE PROPERTIES OF NON-FUEL REACTOR MATERIALS. J. C. Tobin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), M. S. Wechsler, and A. D. Rossin. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented on radiation effects on embrittlement, tensile properties, and creep and stress-to-rupture of reactor structural materials. Radioinduced atomic rearrangements are also included. Patterns of nuclear alloy behavior in nuclear environments were disclosed. 61 references are given. (P.C.H.)

32217 (BLG-190) MAGNETISCHE-SUSCEPTIBILITEITSMETINGEN AAN NEUTRONENBESTRAALD LITHIUMFLUORIDE. (Magnetic Susceptibility Measurements on Neutron-Irradiated Lithium Fluoride). A. Van Den Bosch (Centre d'Etudes pour les Applications de l'Energie Nucleaire, Brussels). Mar. 1963. 173p.

Thesis submitted to Ghent, Rijksuniversiteit.

The construction, the calibration, and the reproducibility of an apparatus to measure the magnetic susceptibility of small solid samples are described. The optimal measuring ranges are: 10^{-8} e.m.u. > m.χ > 10^{-6} e.m.u., 85°K < T < 300°K, and 6.10^3 oersted < H < 17.10^3 oersted. Data of thermal neutron irradiated LiF single crystals are discussed. The susceptibility may be explained as composed of three parts: (1) the diamagnetic part of the normal LiF matrix, (2) a temperature dependent paramagnetic part obeying the Curie law due to unpaired electrons, and (3) a temperature independent paramagnetic part attributed to metallic lithium; the precipitation of this metal phase is discussed. (auth)

32218 (BLG-204) ESSAI D'INFLAMMATION D'URANIUM NATUREL IRRADIE ET EXAMEN DU DEGAGEMENT DE PRODUITS DE FISSION QUI EN RESULTE. (Ignition Tests on Irradiated Natural Uranium and Examination of the Release of Resultant Fission Products). (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay and Centre d'Étude l'Énergie Nucléaire, Brussels). May 1963. 29p.

An experiment conceived by CEN-Mol and performed together by CEN-Mol and CEA-Saclay, consisted in the partial burning of a slightly irradiated BR1 type fuel element; the purpose of the experiment was to get information about the combustion kinetics and the resulting fission products release. The report describes the experimental set-up and the results obtained for temperatures, weight of burned uranium, and fission products release. The experimental method is analyzed and possible improvements for future experiments are proposed. (auth)

32219 (CEA-R-2372) RÉALISATION D'UN APPAREIL POUR LA MESURE DE LA CONDUCTIBILITÉ THERMIQUE À BASSE TEMPÉRATURE, AVANT ET APRÈS IRRADIATION NEUTRONIQUE. APPLICATION AU DIOXYDE D'URANIUM. (Construction of an Apparatus for Measuring the Low Temperature Thermal Conductivity Before and After Neutron Irradiation. Application to Uranium Dioxide). Olivier Bethoux (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1963. 55p.

Thesis submitted to Université, Grenoble, France.

An apparatus has been studied and built which makes it possible to alternatively irradiate a sample at room temperature in the reactor Melusine at the Grenoble Nuclear Research Centre, and to measure its thermal conductivity between 20 and 100°K in perfect safety. The results obtained on UO_2 have made it possible on the one hand to check experimentally that the spin-phonon diffusion leads to a thermal resistance independent of temperature above 30°K, and on the other hand to propose a simple theory which takes into account the role played by the damage due to ^{235}U fission products in the decrease of thermal conductivity after irradiation. (auth)

32220 (CONF-589-1) NEUTRON DOSIMETRY PROCEDURES FOR NMPO EXPERIMENTS IN THE ETR. Paul S. Olson, Farrel L. Sims, and John Moteff (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Sept. 26, 1962. Contract [AT(11-1)-171]. 30p. (TM-62-828)

From the American Nuclear Society Meeting, Columbus, Ohio, Sept. 1962.

The thermal- and fast-neutron doses on structural metal specimens exposed in the ETR 99 facility were established by analyzing the irradiated specimens for isotopes of Cr, Fe, Ni, and Co. Inaccurate results were obtained initially by using the fission averaged cross section for the fast-neutron detectors and by assuming the thermal neutron cadmium ratio correction for cobalt was high (~10). Later, predictions were made of the neutron spectrum on the samples using a diffusion theory computer program. Agreement among the isotopes was apparent after application of cadmium ratio corrections for the thermal neutron detectors and response corrections for the fast neutron threshold detectors. External Ni-Co dosimeters were also used. (auth)

32221 (GA-4557) IRRADIATION OF B_4C–GRAPHITE CAPSULES (GA-032-1A1 AND -2A2). G. B. Engle (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 30, 1964. Contract AT(04-3)-314. 16p.

Extruded B_4C–graphite samples containing 30 wt % boron dispersed in a graphite matrix expanded when irradiated at approximately 300 to 340°C for six cycles in

the GETR core. Hot-pressed samples exhibited both expansion and contraction. Several samples fractured, indicating that high-temperature fabrication (>2500°C) may be an important factor resulting in severe radiation damage. Helium retention within B_4C particles and graphite crystals may cause expansion, although this is only speculative at this time. The stability of B_4C–graphite of 30 wt % boron appears to be more dependent on thermal neutron damage (n,α reaction) than on fast neutron damage to the matrix. (auth)

32222 (HW-SA-3477) IN-REACTOR CREEP OF COLD-WORKED ZIRCALOY-2. J. J. Holmes, J. A. Williams, D. H. Nyman, and J. C. Tobin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 16, 1964. Contract AT(45-1)-1350. 22p. (CONF-512-7)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

The creep properties of 20 per cent cold-worked Zircaloy-2 during neutron irradiation were determined in the temperature range 275 to 465°C and stress range 20,000 to 35,000 psi. In general, the effects of neutron irradiation on creep are small; however, some differences between in-reactor and ex-reactor tests exist. The activation energy for creep during irradiation is around 90,000 cal/mole. In the absence of irradiation, the activation energy is about equal to the self diffusion value of 60,000 cal/mole. During reactor outages, a small increase in creep rate occurs. The time required to initiate the increase after a shutdown decreases with increasing temperature. Considerable recovery of creep resistance due to cold working appears to occur during ex-reactor creep. No measurable decrease in resistance occurs during irradiation; however, any change in creep resistance may have been obscured by radiation effects. During neutron irradiation, the steady state creep rate can be expressed in terms of the Arrhenius rate equation in the following manner: $\dot{\epsilon} = 2.5 \times 10^{20} \exp 5.31 \times 10^{-4} \sigma \exp^{-(90,000/RT)}$ where σ = stress, T = temperature, $\dot{\epsilon}$ = creep rate, and R = gas constant. In addition, total creep strain prior to the first reactor outage can be expressed as a function of Dorn's theta parameter: $\epsilon = f [t \exp^{-(90,000/RT)}, \sigma]$ where t = time. With the aid of the theta and Arrhenius correlations, in-reactor data can be extrapolated over a wide range of temperatures. (auth)

32223 (IFA-FT-51) EFFECT OF DISPLACEMENT CASCADES, PRODUCED BY IRRADIATION, ON RESIDUAL RESISTIVITY OF METALS. A. Babcenco and A. Corciovei (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1964. 20p.

In a metal where nonsuperposed distant displacement cascades are produced, the total resistivity variation is equal to the sum of the resistivity variations due to each individual cascade. The residual resistivity variation, due to a single cascade, was studied by specially taking into account the correlation between interstitials and vacancies of the cascade, by means of the distribution function of the interstitials, respectively, of vacancies. The ratio between the resistivity variation due to the cascade and the "ideal" resistivity variation corresponding to the production in the metal of an equal number of independent interstitial-vacancy pairs, decreases with the increase of the number of cascade pairs. This result may explain why the resistivity variation experimentally obtained by metal irradiation is smaller than the resistivity variation, which would theoretically result, by simply summing up the contributions to resistivity due to each individual defect. (auth)

32224 (ORNL-TM-862) POSTIRRADIATION EXAMINATION OF ORR LOOP 1 ADVANCED FUEL ELEMENTS. M. F. Osborne, E. L. Long, and J. G. Morgan (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 44p.

Five experimental fuel elements of an advanced design were irradiated in ORR Loop 1. The elements were composed of sintered UO_2 fuel pellets in stainless steel cladding and were 12 to 18 in. long. The surfaces of the elements were equipped with spiral fins to provide an increased heat transfer area. Nominal cladding temperature was 1500°F, and design heat ratings varied from 50,000 to 65,000 Btu/hr ft. Three of the elements exhibited no significant changes as a result of the irradiation, but the other two elements were overheated and suffered cladding ruptures. These high-temperature failures were caused in one case by insufficient coolant flow and in the other as a result of a damaged area in the cooling fins. Two of the unfailed elements had faulty braze joints. (auth)

32225 (ORNL-TM-877) POSTIRRADIATION EXAMINATION OF EGCR PROTOTYPE CAPSULE 02A-6. M. F. Osborne, E. L. Long, Jr., and J. G. Morgan (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 31p.

Capsule 02A-6 was the eighth in a series of EGCR prototype diameter capsules. It was constructed with production run fuel and cladding material. Hollow pellets of sintered UO_2 were contained in 0.75 in. OD by 0.020 in. wall stainless steel tubing. Operational data indicated unusual temperature conditions at various stages of the irradiation, and the capsule was removed from the reactor because of an apparent failure. Postirradiation examination revealed that both the capsule cladding and the surrounding NaK vessel had fractured. The UO_2 had been subjected to very high temperatures (>1600°C) as evidenced by columnar grain growth and reaction with the MgO end spacers. The outside surface of the NaK vessel had been heavily nitrided by the control gas. The failure is attributed to excessive stresses on the cladding caused by high temperature in the fuel. (auth)

32226 (ORNL-TM-880) THE EFFECT OF IRRADIATION ON THE BEND TRANSITION TEMPERATURES OF MOLYBDENUM- AND NIOBIUM-BASE ALLOYS. H. E. McCoy and J. R. Weir (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 51p. (CONF-512-8)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

Because of the potential use of refractory metals as structural materials in nuclear reactors, it is necessary that the influence of irradiation on the ductility of these materials be evaluated. The present study is concerned with the development of suitable test equipment for evaluating the ductile-to-brittle transition temperature of irradiated specimens and with the use of this equipment to evaluate the ductile-to-brittle temperature for several irradiated specimens. The equipment developed for this purpose fits in a standard tensile machine and is capable of remote operation over the temperature range of −73 to 261°C. The materials studied after irradiation to a neutron dosage of the order of 10^{20} nvt (>1 Mev) include Mo−0.5% Ti, Nb−1% Zr, welded Nb−1% Zr, and D-43 (10% W−1% Zr−0.1% C). The variables studied were (1) the metallurgical state of the material prior to irradiation, (2) irradiation dose, and (3) postirradiation annealing. The transition temperature of the Mo−0.5% Ti was determined on the basis of the deflection of the material prior to frac-

ture. The behavior of the Nb–1% Zr and D-43 alloys was analyzed on the basis of the yield strength. (auth)

32227 (PA-TR-3157) INADEQUACY OF THERMAL INITIATION THEORY IN INTERPRETING RESULTS OF FISSION-FRAGMENT IRRADIATION OF EXPLOSIVES AT ELEVATED TEMPERATURES. James F. Mallay, Henry J. Prask, and Joseph Cerny (Picatinny Arsenal. Feltman Research Labs., Dover, N. J.). June 1964. 19p.

An extreme test of the "hot-spot" model of explosive initiation as applied to microscale irradiation events should occur when the explosives are irradiated at elevated temperatures. To test this model, fission-fragment irradiations of four explosives selected for their high reaction rates (RDX, HMX, PETN, and nitroglycerin) were performed at 125 to 215°C. No explosions or signs of thermal decomposition were observed with any of the explosives. Since a detailed analysis of the resulting cylindrical zones of radiation heating and their subsequent behavior with time predicts initiation for these particular explosives, it appears that the hot-spot model is inadequate in describing microscale irradiation phenomena. (auth)

32228 (SC-R-64-182) NEUTRON-INDUCED DAMAGE TO SILICON RECTIFIERS. S. K. Manlief (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 19p. (CONF-617-2)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

As transistors become more radiation tolerant, renewed importance must be attached to the degradation of diode performance in a radiation environment. The dominant effect in most rectifiers is the increase in series resistance due to the removal of majority carriers from the conduction process in the base material. The initial conductivity of the base material and recent experimental data on carrier removal rates are used to predict the amount of degradation in the electrical characteristics of a rectifier exposed to a neutron environment; the initial conductivity of the base material may be obtained from diode design information or it may be estimated from the value of the avalanche breakdown voltage. Experimental data are presented which, in general, substantiate the predictions. In particular, diodes with a breakdown voltage of less than 100 volts appear to be usable to neutron fluxes in excess of 10^{14} n/cm^2. Gold doping seems to increase radiation tolerance. (auth)

32229 (SC-R-64-191) TEMPERATURE DEPENDENCE OF PHOTOCONDUCTIVITY INDUCED IN POLYSTYRENE BY TRANSIENT RADIATION. F. N. Coppage and F. C. Peterson (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 15p. (CONF-617-3)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

The results substantiate the existence of an internal field which results from a trapped space charge and reaches a stable condition (or saturation) after the sample has received a very small radiation dose (~20 rads at –80°C). The dose required for saturation is temperature dependent, increasing with higher temperatures. The trapped space charge results from a long-lived migration of charge carrier with the subsequent trapping of these carriers at metastable states, thereby creating the internal field whose effects are readily observed. The observed charge migration continues for seconds following the excitation pulse, although the observed photocurrent of the long-lived component is several orders of magnitude smaller than during the excitation pulse. It is the effects of temperature upon these metastable trapping states which lead to the observed temperature dependent properties; i.e., the ease of establishing and removing the trapped space charge. It is the presence of the internal field and its effective reduction of the applied field which causes the reduction of photoconductivity with sequential exposures to gamma-ray pulses. Therefore, the relationship of the derived equation and the contained empirical constants remain unchanged for a given situation. All attempts to measure an activation energy for polystyrene in a space charge free condition during the 0.1 microsecond gamma-ray pulse used for excitation purposes have resulted in data which are meaningless in terms of photoconductivity and its control by traps at discrete energy levels within the forbidden gap. It is possible that contact behavior may play a significant role in some aspects of the described phenomena; however, a method of separating bulk properties from contact properties is not apparent with the present experimental samples and techniques. In attempting to obtain an approximation of a basic property such as mobility, several assumptions which are basically unsubstantiated are necessary. For instance, if one assumes that an absorbed energy of 20 ev is required to form an ion pair, and that the lifetime is of the order of the pulse duration (0.1 microsecond), then a schubweg of 1×10^{-6} cm and a mobility of $\geq 7 \times 10^{-5}$ cm^2/v-sec are calculated for the photoconductivity measured during the gamma-ray pulse. The value of mobility is in good agreement with a value of 1×10^{-4} cm^2/v-sec found in the literature. Nevertheless, the above values are highly speculative, and at best should be considered as rough estimates with broad limits. (auth)

32230 (SC-R-64-192) ROOM TEMPERATURE ANNEALING OF SILICON TRANSISTOR PARAMETERS DEGRADED BY A BURST OF NEUTRONS. H. H. Sander (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 7p. (CONF-617-4)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

Short time changes in transistor parameters are observed following exposure to a neutron pulse from the Sandia Pulsed Reactor Facility. After a few hundred seconds, a stable condition is achieved. In extreme cases, the gain observed at 1 millisecond following the burst may be equivalent to a gain in the stable condition corresponding to a neutron exposure of twice the actual integrated flux. Detailed information on several transistor types is given. (auth)

32231 (SC-R-64-193) INTRODUCTION RATE OF ELECTRICALLY ACTIVE DEFECTS IN SILICON BY NUCLEAR RADIATION. H. J. Stein (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 10p. (CONF-617-5)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

The dependence of the hole removal rate in p-type silicon on the crystal growth method, hole concentration, and dopant impurity has been investigated. Electrical conductivity measurements at 270°K as a function of fission spectrum neutron and 2 Mev electron irradiation are used to determine the removal rates. The hole removal rates are observed to increase with hole concentration as $p^{0.32}$ for neutron irradiation, and they are essentially independent of crystal growth methods and dopant impurity. The influence of the crystal growth method on the hole removal rate is increased by isochronal annealing to 100°C. The hole removal rate for electron irradiation is a more complex function of the hole con-

centration and an influence of crystal growth method is observed at 270°K. (auth)

32232 (SC-R-64-194) THE TRANSIENT RESPONSE OF TRANSISTORS AND DIODES TO IONIZING RADIATION. J. L. Wirth and S. C. Rogers (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 23p. (CONF-617-6)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

Mathematical models describing the response of diodes and transistors to ionizing radiation are derived from the continuity and diffusion equations and, in the case of the transistor, the charge control model. Solutions are obtained for both steady-state and transient radiation environments. In addition to being of use in understanding device behavior, these solutions also indicate those device parameters which must be optimized to reduce transient response and therefore provide criteria for the design and/or selection of devices with minimum response. A model is also presented which describes the nonlinear effect of collector multiplication upon the collector photocurrent of a transistor. This model is used as a basis for explaining and predicting the nonlinear relation between the peak photoresponse and the radiation dose which has been observed in some devices. (auth)

32233 (SC-R-64-195) ANOMALOUS BASE CURRENT COMPONENT IN NEUTRON IRRADIATED TRANSISTORS. C. A. Goben and F. M. Smits (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 12p. (CONF-617-7)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

In a transistor the collector current varies with emitter to base voltage as exp(qV/kT), while the base current varies as exp(qV/nkT), where n may have values between one and two. An n of one corresponds to the ideal current component, while an n of approximately two has been explained as arising from space charge recombination. A current component with n of approximately 1.5 at room temperature has recently been identified as originating at the perimeter of the emitter, and it has been thought to arise from surface recombination at the intercept of the emitter base junction with the surface. On neutron irradiation, a base current component with the same slope has been observed to increase proportional to neutron flux. This current component can be identified over several decades in current. From a study of the base resistance through which this current component flows, it could be shown that it is of bulk and not of perimeter origin and must be attributed to recombination in the space charge region. This current component dominates transistor gain over a wide range of current density and is primarily responsible for degradation of transistor current gain by decreasing the emitter efficiency. There is little change in base transport factor and base region parameters. (auth)

32234 (SC-R-64-196) ON THE ENERGY DEPENDENCE OF NEUTRON DAMAGE IN SILICON TRANSISTORS. F. M. Smits (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 6p. (CONF-617-8)

From Special Technical Conference on Nuclear Radiation effects, Seattle, July 1964.

The effects of neutron bombardment by reactor spectrum and 14 Mev neutrons on transistors, bulk silicon, and solar cells are compared. A suitable parameter which varies linearly with integrated flux is used for each device. It is found that the damage rates for reactor and 14 Mev neutrons do not have the same ratio for the different types of devices. However, it can be concluded that, for all the device types, the number of fission neutrons producing the same amount of damage as one 14 Mev neutron will fall into the range of 3 ± 1. (auth)

32235 (EURAEC-1068) INVESTIGATION OF THE EFFECTS OF NEUTRON RADIATION ON THE PROPERTIES OF ALLOY ZrNb3Sn1. Quarterly Report No. 7, January 1–March 31, 1964. H. Richter (Metallgesellschaft A. G., Frankfurt am Main); W. Spalthoff, and E. Starke (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany). Apr. 27, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 092-62-7-RDD. 20p. (A translation)

Tests were made in a swimming pool reactor to ascertain the effects of neutron radiations on the mechanical properties and the corrosion behavior of Zircaloy-2 and Zr–Nb–Sn alloy. When the radiation dose is increased, the mechanical properties tend toward a limit value. The radiation of both autoclaves was completed, the planned Mwh having been attained. Tests of corroded specimens were started from these and parallel autoclaves without radiation. (auth)

32236 EFFECTS OF γ-IRRADIATION UPON LIFETIME AND LUMINESCENCE OF GaP DIODES. R. A. Logan, H. G. White, and R. M. Mikulyak (Bell Telephone Labs., Inc., Murray Hill, N. J.). Appl. Phys. Letters, 5: 41-2(Aug. 1, 1964).

Diodes were made by the diffusion of zinc into n-type, Te-doped, GaP crystals grown from Ga solution. The electroluminescent quantum efficiency, ϵ, varied with minority carrier lifetime, τ, the smaller values of ϵ being obtained in diffused layers $\lesssim 25\ \mu$ deep. After irradiation at room temperature with gamma rays from a ^{60}Co source producing 5.6×10^5 r per hour, ϵ and τ were reduced, while the capacitance-voltage and current-voltage characteristics were changed to within experimental reproducibility. The reduction in intensity of the individual bands in the electroluminescent spectrum with irradiation and their correlation with τ suggest that all the bands are generated outside the junction space-charge region by injected current. (L.B.S.)

32237 THERMOELECTRIC CONDUCTOR UNDER NEUTRON IRRADIATION. R. Schroeder. Atompraxis, 10: 276-8(June 1964). (In German)

Materials for thermoelements, chromel, alumel, iron, copper, constantan, platinum, rhodium, tungsten, and rhenium, were thermal and fast neutrons. The result was an increase in temperature of the material. (M.C.G.)

32238 EFFECTS OF IRRADIATION ON THE PHYSICAL PROPERTIES OF GRAPHITE. J. Rappeneau, M. Bocquet, G. Micaud, and A. Fillatre (CEN, Saclay, France). Carbon, 1: 97-109(Feb. 1964). (In French)

The effects of radiation on graphite were studied by using specimens irradiated in reactors with graphite moderators. Methods of measurement were devised to follow the increase in energy or the changes effected in the thermal conductivity and the crystalline parameters in relation to time. After briefly reviewing these methods, the increase in the internal energy and the effects on the thermal conductivity and the crystalline parameters were discussed in relation to the dose of irradiation (maximum dose 1×10^{21} n cm^{-2}) and for radiation temperatures varying from 50 to 300°C. The results obtained concerning the

internal energy, the relative variations in the thermal conductivity, and the crystalline parameters were in complete agreement with those found by others. The effects of radiation on graphite that was heated and then re-irradiated, i.e., material having undergone several cycles, were different from those observed with graphite that had never before been irradiated. A preliminary effect was observed; at the beginning of the re-irradiation, whatever the operating temperature, the effects increased rapidly up to doses of the order of 0.3×10^{20} n cm^{-2}, then proceeded at a slower rate. The preliminary effect would seem to exert an influence on the principal physical properties of graphite. (auth)

32239 VARIATION WITH THE TEMPERATURE OF THE PARAMAGNETIC RESONANCE SIGNAL OF NEUTRON-IRRADIATED POLYCRYSTALLINE GRAPHITE. Maxime Nechtschein and Tilo Kester (CEN, Grenoble, France). Carbon, 1: 143-5(Feb. 1964). (In French)

Electron spin resonance absorption of heavily neutron-irradiated polycrystalline graphite was studied in the temperature range of 1.25–293°K. The reported sample was irradiated by 3.9×10^{17} fast neutrons per cm^2 at 50°C in the swimming pool reactor Melusine in Grenoble. The obtained resonance signal shows an asymmetric line shape predicted by Dyson's theory for the resonance absorption in conductors (asymmetry parameter A/B = 2). In order to obtain the temperature dependence of the intensity of the signal the resonance of graphite was compared with that of a MgO crystal containing a certain amount of Mn^{2+}. It was found that the temperature dependence for both lines is nearly identical (Curie law). Thus, considering the Curie law and the value of the asymmetry parameter the observed resonance seems to be due to equally distributed localized spin centers about the sample. (auth)

32240 DIMENSIONAL CHANGES IN THE IRRADIATED GRAPHITE LATTICE. P. R. Goggin, R. W. Henson, A. J. Perks, and W. N. Reynolds (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Carbon, 1: 189-200(Feb. 1964). (AERE-R-4243)

New experimental results on dimensional changes in various kinds of graphite irradiated in high flux materials testing reactors at 200 and 650°C are presented. All the behavior was analyzed in terms of a model, and corrected values were deduced of the dimensional changes characteristic of single crystallites. Observations were also made of the changes due to irradiation of coefficients of thermal expansion of graphite natural compact. New data on the thermal annealing of dimensional changes are interpreted in terms of the model. (auth)

32241 OPTICAL STUDY OF 77°K OF LITHIUM FLUORIDE MONOCRYSTALS IRRADIATED WITH THERMAL NEUTRONS AT THE SAME TEMPERATURE. Yves Farge and Marianne Lambert (Faculte des Sciences, Orsay, France). Compt. Rend., 258: 5199-5202(May 25, 1964). (In French)

The irradiation of lithium fluoride with neutrons at low temperature causes the appearance, in addition to the known bands, of a specific absorption band corresponding to a wave length of 5500 Å. The band appears with a minimum dose of 10^{16} neutrons/cm^2. An interpretation is proposed, attributing this absorption band to interstitial lithium. (tr-auth)

32242 DISTRIBUTION OF THE POTENTIAL IN CERAMICS OF IRRADIATED BARIUM TITANATE. Genevieve Godefroy (Faculte des Sciences, Dijon, France). Compt. Rend., 258: 5410-13(June 1, 1964). (In French)

The distribution of the potential along a ceramic sample of barium titanate irradiated in the middle of the sample was studied by use of the vibrating wire method. The motions of different charges produced by the irradiation are shown. (tr-auth)

32243 ELECTRICAL PROPERTIES OF GERMANIUM IRRADIATED AT 77°K WITH FAST NEUTRONS. R. F. Konopleva and S. R. Novikov. (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Tverd. Tela, 6: 1062-7(Apr. 1964).

The electrical conductivity and Hall effect were investigated in n- and p-Ge specimens irradiated with fast neutrons in a reactor at 77°K. Annealing of these specimens over the range of 100–600°K occurs in several stages, which are described as processes of "ripening" of the defects and the unipolar annealing of donor and acceptor centers. The activation energies of individual annealing processes were determined. The question on the limiting position of the Fermi level in Ge irradiated with fast neutrons was examined. (OTS)

32244 ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED COALS. Sadaharu Toyoda (Resources Research Inst., Saitama, Japan). Fuel, 42: 431-43(Nov. 1963).

The esr of gamma irradiated coals maintained in air for about one and four months, respectively after irradiation was measured in vacuo (the first and second measurements). From the relation between the line-shape variation and the rotating component of the microwave magnetic field, H_1, it was found that a narrow component ($\Delta H''_{msl} \approx$ 3 gauss), newly produced by gamma irradiation, is superimposed on a broad component ($\Delta H'_{msl} \approx 8$ gauss), which is almost equal to the esr signal of the original coal. The spin concentration of the narrow component is not proportional to the irradiation dose. The narrow component cannot be detected in the second measurement. (auth)

32245 THE NATURE AND ANNEALING BEHAVIOUR OF FISSION FRAGMENT DAMAGE IN MOLYBDENUM. P. R. B. Higgins and A. C. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 6: 472-83(June 1964). (AERE-R-4390)

Electron microscope studies were made of the formation of point defect clusters in pre-thinned foils of molybdenum bombarded by fission fragments at two dose rates. The post-irradiation annealing behavior of the irradiation damage was studied. After annealing at 950°C the loops lay on or close to {111} planes and their Burgers vectors were perpendicular to the loop plane. Analysis of the dislocation loops by there techniques showed them to be of interstitial origin. (auth)

32246 IRRADIATION GROWTH RATES OF MECHANICALLY WORKED AND ALLOYED URANIUM. G. F. Slattery and D. E. Connolly (United Kingdom Atomic Energy Authority, Salwick, Lancs, Eng.). J. Nucl. Energy, Pts. A & B, 18: 347-59(June 1964).

A method for mathematically formulating sets of p-values into a single index descriptive of the irradiation growth rate to be expected of the material to which they refer is applied to mechanically worked and to alloyed uranium. For uranium rolled within controlled temperature ranges, the growth index decreases with increasing temperature of rolling for a given reduction in area. Rolling at room temperature builds up a single (010) texture rapidly with increasing reduction. The compression texture is centered around the [114], [113], and [112] pole directions. The growth index in the rolling direction increases with increasing deformation. Beta heat-treatment of rolled ura-

nium followed by water quenching substantially reduces the growth index. The texture of extruded uranium varies along the length of the rod. This variation can be correlated with micro-structure. At the front of the rod, there is a duplex (010)(110) texture associated with warm extrusion. In the middle the texture is (130) to (131), which is more representative of a recrystallization texture. At high reductions and temperatures of extrusion, a predominantly (100) texture is developed that leads to a negative growth index. A single β-quenching operation reduces the texture in extruded uranium, particularly the [100] component. Subsequent β-quenching appears to regenerate the texture. The effect of small additions of molybdenum, chromium, and aluminum on the hot-rolled textures is to increase the (010) tension texture and reduce the (110) texture. For the same rolling conditions, the alloys have higher growth rates than unalloyed uranium. (auth)

32247 RADIATION EFFECTS IN SOLIDS. J. J. Loferski (Brown Univ., Providence). Nucl. Instr. Methods, 28: 109-18(June 1964).

The requirements imposed on a Van de Graaff machine intended for solid state research are discussed. Voltage calibration, a voltage stabilizing circuit, a current ratio recorder, beam deflection and pulsing and vacuum problems are described. Some recent experiments performed with electron accelerators are then reviewed including studies of damage thresholds, recombination radiation and solar cell radiation damage. (auth)

32248 IRRADIATION OF FUEL RODS WITH THIN-WALLED STEEL CLADDING. R. Holzer and H. Stehle (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 6: 103-9(May 1964). (In German)

Irradiation research on fuel rods of natural uranium dioxide tablets in thin-walled steel claddings with wall thickness of 0.12 mm is reported. The samples were inserted for a complete reactor cycle in noninstrumented capsules in the General Electric Test Reactor and reached a mean rod power of 410 w/cm. The postirradiation studies included visual research, dimension measurements, leak testing, ^{137}Cs burnup analysis, and the preparation of metallographic specimens. Only trivial length and diameter variations were found, and neither dislocations nor fissures appeared in the cladding or detectable rod distortions. The compatibility of the UO_2 with the cladding and the aluminum oxide insulators was good. Slight grain growth was established in the center of the fuel tablet. The comparison with "out-of-pile" grain growth research leads to a maximum temperature of 1450°C. (tr-auth)

32249 NEW DATA ON THE SPECTRUM OF COLORED LiF CRYSTALS. I. S. Gorban and V. B. Timofeev. Opt. i Spektroskopiya, 16: 638-41(Apr. 1964).

In the visible region of the spectrum at 20°K, x irradiated LiF crystals have a series of narrow absorption lines converging to the short wave side. Comparison with the luminescence spectrum permitted isolation of a mirror-symmetrical series of lines in the latter. The results are explained on the basis of the assumption of electron-vibrational transitions in the complex color centers of LiF. (OTS)

32250 ELECTRON TRAPS IN KCl QUENCHED FROM THE MELT. R. V. Joshi and A. K. Menon (M. S. University, Baroda, India). Phys. Letters, 10: 262-3(June 15, 1964).

The occurrence of a pronounced glow peak at 250°K, reported by B-raner and Halperin, in x-irradiated KCl is discussed by the vacancy pair model. (L.B.S.)

32251 CHANGES IN THE FERROELECTRIC PROPERTIES OF $BaTiO_3$ CERAMICS CAUSED BY IRRADIATION WITH Cd-TRANSMITTED NEUTRONS. B. Hilczer (Inst. of Physics, Polish Academy of Sciences, Poznan). Phys. Status Solidi, 3: K113-K115(1964).

In order to verify whether thermal neutrons actually affect the ferroelectric properties of $BaTiO_3$, a study was made of ceramics that were irradiated with pile neutrons as well as fast neutrons transmitted by a 0.4 mm Cd foil. Measurements were made of the changes in the temperature dependence of permittivity, in the dielectric polarization, and the coercive field. It was found that, within experimental error, irradiation with pile neutrons leads to the same changes in the ferroelectric properties of $BaTiO_3$ ceramics as irradiation with neutrons transmitted by a cadmium foil. It was concluded that the changes in the ferroelectric properties of $BaTiO_3$ are primarily due to fast neutrons, and not to thermal neutrons. (P.C.H.)

32252 THE RADIATION ANNEALING OF FRENKEL DEFECTS. AN APPROACH BASED ON A SIMPLE STATISTICAL MODEL. G. Lueck and R. Sizmann (Technische Hochschule, Munich). Phys. Status Solidi, 3: 683-91(1964).

Radiation annealing is considered for the particular case of spontaneous recombination of a vacancy and an interstitial that lie closer together than a certain critical distance. By employing a simplified statistical method, a generalized theoretical dose curve is obtained. The theoretical results were applied to experimental data on deuteron- and alpha-irradiated noble metals and nickel. The experimental data suggest that the number of unstable lattice positions of a vacancy around an interstitial, which give rise to the spontaneous recombination, is of the order of 150. (auth)

32253 FISSION FRAGMENT DAMAGE TO CRYSTAL LATTICES: TRACK CONTRAST. L. T. Chadderton (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 280: 110-22(July 7, 1964).

A model is established for the damage produced by a fission fragment in an initially perfect crystal. This essentially consists of a central cylinder of disturbed material surrounded by a radial strain field, and is mathematically very similar to the model invoked to describe the spherically symmetrical coherency strain. The model is used in conjunction with the two-beam dynamical theory of electron diffraction and machine calculations are made of contrast profiles for tracks at different positions in the crystal and for various values of the parameters involved. A good measure of agreement between experiment and theory is demonstrated, and, in particular, it is shown how anomalous images and oscillatory contrast effects may be explained. Asymmetric images on dark-field micrographs can be used in a determination of the direction of radial strain, and anomalous images in both bright and dark field yield information about the direction of particle travel. A method is suggested for obtaining information concerning the pattern of damage in continuous and discontinuous tracks and for testing the validity of the depleted zone concept. (auth)

32254 NEGATIVE RESISTANCE OF IRRADIATED Ge AND Si DIODES. F. M. Berkovskii and R. S. Kasymova (Ioffe Inst. of Physics and Tech., Leningrad). Radiotekhn. i Elektron., 9: 899-901(May 1964). (In Russian)

Deep irradiation with 3-Mev fast neutrons and γ quanta changed ordinary diodes into negative-resistance diodes. The best results were obtained with silicon because the radioinduced defects were more resistant to annealing. The silicon diodes retained the negative resistance at

room temperature and at much higher temperatures. (R.V.J.)

32255 THE MAGNETIC INVESTIGATION AND SIGNIFICANCE OF THE POINT FAULTS, THAT ARE PRODUCED IN A FERROMAGNETIC METAL BY RADIATION. Louis Neel (Faculté des Sciences, Grenoble, France). Z. Angew. Phys., 17: 113-20(Apr. 1964). (In German)

The various types of lattice faults occurring in metallic construction materials in reactor irradiation are classified. On the basis of economic considerations it is shown that purely empirical investigation methods are uneconomic and unsatisfactory and must be replaced by basic research. It is demonstrated that for the investigations of point errors, the study of the magnetic diffusion secondary effect is especially suitable since with this method a high sensitivity, a selectivity, and a possibility for the determination of fault symmetries are present. The significance of the diffusion secondary effect was indicated with recent results from Grenoble. Investigations on single crystals of an iron–silicon alloy by Brissonneau showed that the faults producing the secondary effects are probably adjacent Si pairs. The investigation of the secondary effect on zone-fused iron irradiated at 77°K with reactor neutrons showed four different regions of secondary effects from –190 to +100°C. The various point faults could be classified. After glowing the irradiated sample at temperatures over 300°C, a strong and very stable secondary effect appeared that was explained by small agglomerates of holes. Investigations on cubic face-centered nickel showed that interstitial lattice atoms play a role in the origin of the secondary effects. Adjacent atoms are laterally displaced. Irradiation with neutrons leads not only to lattice faults but to the introduction of new equilibrium sites in the lattice. Paulve and Dautreppe produced a new quadratic superstructure in a 50% Ni–50% iron alloy by reactor irradiation. The superstructure existed under 325°C, and was constructed of adjacent and alternating layers of Fe and Ni atoms. (tr-auth)

32256 EFFECTS OF THE STRUCTURE ON THE WEAK ACID CATIONITE RESISTANCE TO RADIATION. A. M. Semushin and I. A. Kuzin. Zh. Prikl. Khim., 37: 760-4 (Apr. 1964). (In Russian)

The radiosensitivity of methacrylic acid base KMT, SG-1, and KB-4P-2 cationites was studied, and the influence of their ionite structure on their radioresistance was analyzed. It is shown that the losses in the specific capacity and the swelling of the resins depend on the nature and quantity of their crosslinks. Studies of high-radioresistance benzene base KS, KFU, and Vofatite S showed that the benzene nuclei in the macromolecule elementary links improved the radiochemical resistance of the resins. (R.V.J.)

32257 GAMMA RADIATION DAMAGE IN P-I-N JUNCTIONS. J. A. Coleman (Bell Telephone Labs., Inc., Murray Hill, N. J.). 12p. (CONF-452-30)

From American Physical Society Meeting, Washington, D. C., Apr. 1964.

Gamma radiation effects on lithium drifted silicon p-i-n junctions were investigated. The capacitance of the junctions at lower reverse biases increased with radiation damage. Thus, it appears that radiation damage introduces donor or acceptor defect levels in the junction that lowers the degree of compensation as originally achieved by lithium drifting. Changes in collection time and collection efficiency were measured as a function of radiation damage. The results showed that the (10–90%) rise time, t_r, increased with damage at lower biases, and the effective carrier (electrons in this case) drift velocity was also reduced. The charge collection efficiency also decreased with radiation damage. (P.C.H.)

32258 EFFECTS OF NEUTRON IRRADIATION ON THE STRESS-RUPTURE PROPERTIES OF HIGH-TEMPERATURE PRECIPITATION HARDENING ALLOYS. J. Moteff, F. C. Robertshaw, and F. D. Kingsbury (General Electric Co., Cincinnati). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-364, 11p. $1.00. (CONF-600-6)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Studies to determine the threshold neutron dosage in which observable changes in the stress-rupture properties of an iron base (A-286) and a nickel base (René 41) precipitation hardening alloy may be detected are described. Specimens were irradiated at a temperature of approximately 650°C to fast ($E_n \geq 1$ Mev) and thermal neutron dosages as low as 8.3×10^{14} and 4.4×10^{15} nvt, respectively. Post-irradiation stress-rupture tests were conducted at 650°C. The results indicate that there are observable changes in the stress-rupture properties of these alloys even at the relatively low neutron exposure. The rupture ductilities, especially, were significantly reduced as a result of the irradiations. A preliminary model explaining the observed effects of the neutron irradiation on the elevated temperature embrittlement is presented. This model is based on the concentration of boron in the grain boundaries and the changes in the substructure of the grain boundary region as a result of the $^{10}B(N,\alpha)^{7}Li$ thermal neutron reactions. (auth)

METEOROLOGY

32259 (BNL-859) A DIFFUSION-DEPOSITION TRACER SYSTEM. Gilbert S. Raynor and Maynard E. Smith (Brookhaven National Lab., Upton, N. Y.). Apr. 1964. Contract AT-30-2-GEN-16. 19p.

A dual tracer technique has been developed for use in experiments in low-level atmospheric dispersion and deposition. The system is considered unique in two respects. First, it permits definition of the airborne concentrations of a cloud of small particles representative of a ture aerosol and simultaneously the deposition of larger particles on the soil and vegetation beneath. Second, the deposition tracer consisting of ^{64}Cu particles in the 1 to 10-micron range can be detected directly on the surface without the intervention of any artificial collecting mechanism or the necessity of inferring deposition by mass balance techniques. Techniques, instruments, and facilities for the preparation, activation, emission, sampling, and measurement of both tracers are described in sufficient detail to permit reproduction. (auth)

32260 (HW-62455) METEOROLOGICAL INSTRUMENTATION OF THE HANFORD AREA. W. A. Stone (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1964. Contract AT(45-1)-1350. 24p.

This report lists the meteorological instruments in use in the Hanford Area and gives a brief explanation of how they work. It also includes installation dates, maintenance information, and some discussion of special problems. (auth)

32261 PRESSURE WAVES PRODUCED BY THE LARGE NUCLEAR EXPLOSIONS IN 1961-1962. Nobuhiko Murayama (Japan Meteorological Agency, Tokyo). Kishocho Kenkyu Jiho, 15: 1-14(Mar. 1963). (In Japanese)

In the cases of large explosions at Novaya Zemlya in 1961 and 1962, direct waves, first trains A_1, antipodal waves, second trains A_2, return of the direct waves after a complete global passage, and third trains A_3 were found in the microbarographic records. Observed features of these pressure waves including some new findings are referred to in some detail. Some dispersion curves of group velocity against period exhibit the effects of thermal structure and wind in the atmosphere on propagation of pressure waves. It is possible to trace an inversely dispersed wave train superimposed by a normally dispersed wave train in A_1 waves. The amplitude of the former is extremely low compared with that of the latter. The front of an inversely dispersed wave train of long period merges with that of normally dispersed waves with maximum group velocity. Other inversely dispersed waves having a period shorter than 0.5 minutes are found. The atmospheric effects, especially the effect of wind, on propagation of the waves are discussed. A very rough estimation on magnitude of the large explosion is done. A statistical relation between maximum period and maximum amplitude of the oscillation on the microbarogram is expressed in the form of $P_m = ae^{bA}$ m, where P_m and A_m are respectively maximum period and maximum amplitude, and a and b are constants. (auth)

32262 A COMPARISON OF RADIOACTIVITY OBSERVATIONS IN THE UPPER ATMOSPHERE. Nobuhiko Murayama (Japan Meteorological Agency, Tokyo). Kishocho Kenkyu Jiho, 15: 276-80(Apr. 1963). (In Japanese)

Results of various measurements of radioactivity concentration in the upper atmosphere are compared. At an altitude of 12 km, there is a tendency for quantities obtained from sounding by the radioactivity-sonde to be larger than those from sampling by an airplane. It seems possible that this result is caused by large variability of radioactivity concentration at this altitude and low collection efficiency of a filter used in airplane sampling for small particles. Vertical distributions of radioactivity in the air at Tateno, Japan and Finland are shown in comparison with the United States result. A measurement of 2.6 $\mu\mu c/m^3$ (STP) of ^{90}Sr estimated from the maximum concentration at the altitude of 15 km over Tateno on December 7, 1961, is comparable with an average of 3.2 $\mu\mu c/m^3$ (STP) from January through March measured by the United States. Occurrence of maximum radioactivity concentration and the seasonal variation in the air at a tropopausal height are considered. (auth)

32263 SUPPLEMENT TO THE "PRESSURE WAVES PRODUCED BY THE LARGE NUCLEAR EXPLOSIONS IN 1961-1962". Nobuhiko Murayama (Japan Meteorological Agency, Tokyo). Kishocho Kenkyu Jiho, 15: 361-5(May 1963). (In Japanese)

Of the pressure waves produced from a large nuclear explosion detonated at Novaya Zemlya, on December 24, 1962, direct waves, the first train A_1, antipodal waves, the second train A_2, return of the direct waves after a complete global passage, and the third train A_3 were found in microbarographic records. Maximum amplitude of the waves is subsequent to that of the largest explosion of October 30, 1961. A preceding smaller explosion was detected in the same microbarograms. Short-period wave trains from the preceding explosion are recorded overlapped on long-period waves from the larger one. Records of the pressure waves on aneroid barographs at Torishima and Marcus Island are tabulated for the purpose of drawing the global propagation pattern. (auth)

PHYSICS

General

32264 (BNL-7452) EFFECT OF LONG-RANGE INTERACTIONS ON ORDER. Arthur Paskin (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 19p. (CONF-543-2)

From American Physical Society 1964 March Meeting, Philadelphia, Mar. 1964.

Harrison and Paskin (HP) have calculated the ordering energy of β-CuZn using recent theoretical techniques of treating electron screening and Mott's polar model of an alloy. Good agreement is obtained between the calculated total energy of the order-disorder transformation and specific heat measurements. A consequence of the HP calculation is that the ordering energy is long-range and oscillates in sign. Walker and Keating recently measured the neutron diffuse scattering of β-CuZn above the critical temperature T_c and found their data is in agreement with order calculated by only considering a nearest-neighbor interaction. Using the Cowley statistical theory of order, a comparison is made of the order generated by a nearest-neighbor interaction and the long-range interaction of HP at a temperature $1.1T_c$. We find the average behavior of the order generated by the nearest-neighbor and long-range interaction to be similar. The major difference is the nearest-neighbor interaction generates order that asymptotically varies smoothly with neighbor distance whereas the order resulting from the long-range interaction fluctuates markedly about the nearest-neighbor generated order. This result may explain the success of statistical theories, based on nearest-neighbor interactions, in both order-disorder of alloys as well as in some magnetic systems which are also believed to have a similar long-range oscillatory interaction. (auth)

32265 (CERN-64-30(p.313-14)) ULTRASONIC CAVITATION INDUCED BY NUCLEAR RECOILS. B. Hahn (European Organization for Nuclear Research, Geneva and Fribourg, Switzerland. Université).

The cavitation in CCl_3F due to Pu–Be neutrons and ultrasonic pressure waves is discussed. The paper is a summary of previous articles NSA 17: 23409 and 23646. Fission recoils and alpha-recoils are also considered. (R.E.U.)

32266 (CERN-64-30(p.315-24)) NEUTRON-INDUCED ULTRASONIC CAVITATION. C. West (Liverpool. Univ.).

Effects of nonfocusing of the oscillator used to setup the pressure waves in studies of neutron-induced ultrasonic cavitation are discussed. Power limitations due to spontaneous cavitation at the liquid-soundhead interface are considered. (R.E.U.)

32267 (COO-1198-175) MAGNETIC RESONANCE IN THE ROTATING FRAME. Charles P. Slichter (Illinois. Univ., Urbana). [nd]. Contract AT(11-1)-1198. 4p. (CONF-608-1)

For presentation at International Conference on Nuclear Magnetic Resonance and Relaxation in Solids, 13th Colloque Ampere, Leuven, Belg., Sept. 1964.

Nuclear magnetic resonance in solids is treated by a suitable mathematical transformation equivalent to viewing the problem from a reference frame rotating in the sense of the nuclear precession at the frequency of the applied alternating field. The treatment is analogous to interacting dipoles in the presence of a static magnetic field. (R.E.U.)

32268 (IS-927) THE ISOTOPE SHIFT OF THE URANIUM $K\alpha_1$ X RAY. R. Brockmeier, F. Boehm (California Inst. of Tech., Pasadena), and E. N. Hatch (Ames Lab., Ames, Iowa). June 25, 1964. Contract W-7405-eng-82. 10p. (CONF-614-1)

From Symposium on Crystal Diffraction of Nuclear Gamma Rays, Athens, June 1964.

The nuclear volume dependent isotope shift of optical spectral lines as a means of studying different isotopes of heavy elements is discussed. An attempt was made to observe such an isotope shift in the fluorescent x rays of U. Samples of ^{233}U and ^{238}U in the form of U_3O_8 were used with a Caltech two-meter bent-crystal spectrometer. Care was taken to eliminate errors, and a definite isotope shift of 0.0018 ± 0.0006 XU was observed. Sample placement effects in the holder are discussed. (D.L.C.)

32269 (LADC-6288) EXPLODING WIRE DETONATORS: SWEEPING-IMAGE PHOTOGRAPHS OF THE EXPLODING BRIDGE WIRE INITIATION OF PETN. James H. Blackburn and Robert J. Reithel (Los Alamos Scientific Lab., N. Mex.). Mar. 4, 1964. Contract [W-7405-eng-36]. 28p. (CONF-533-2)

From the 3rd Conference on Exploding Wires, Boston, Mar. 1964.

A rear view photograph is a sweeping-image camera picture taken through a transparent head of a detonator. The photograph gives a continuous record of the propagation of the detonation sidewise away from the exploding wire. The technique was used as early as 1944 by A. Knudsen. The paper reviews the rear-view studies at LASL since 1953 of exploding wires initiating pentaerythritol tetranitrate (PETN). Perhaps the most significant fact revealed by these photographs is that the wire burst generates a shock in the explosive and that this shock accelerates and becomes the detonation. After a brief introduction to a typical photograph, evidence is shown that the initiation at the rear surface of the explosive is representative of the initiation deeper within the charge. Then, particular details of the rear view pictures are considered and, finally, the effects on initiation of varying some parameters of the detonators and firing circuit are considered. (auth)

32270 (LNF-64/2) PRODUZIONE DI FOTONI MONOCROMATICI MEDIANTE L'ANNICHILAZIONE DI POSITRONI IN ELEMENTI LEGGERI. (Production of Monochromatic Photons by the Annihilation of Positrons in Light Elements). Note No. 232. C. Schaerf (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 30, 1964. 5p.

An n-th term calculation is made of the production of photons by the annihilation of positrons in light elements. It is compared with the production of normal bremsstrahlung. For simplicity only annihilation in hydrogen is considered. A simple rule for extrapolating the results when elements other than hydrogen are used is given. (J.S.R.)

32271 (MATT-208) DESIGN OF FORCE-FREE TOROIDAL MAGNETS. Kenneth E. Wakefield (Princeton Univ., N. J. Plasma Physics Lab.). Mar. 1964. Contract AT(30-1)-1238. 20p. (CONF-583-1)

From the Conference on High Magnetic Fields, Their Production, and Their Applications, Oxford, July 1963.

The severity of the problem of force containment inherent in the design of much of the apparatus used to

produce magnetic fields for plasma physics research leads to the consideration of possible means to produce such fields through the use of force-free coil systems. A dual element coil system in which one element, comparable to the confining field coil system of a stellarator, generates a toroidal field by means of a force-free, thick layer of conductors is described. The second, remote element, consisting of simple coil shapes that can more easily be supported, carries the only forces in the system. Physical characteristics of the system such as the size and shape of the experimental cavity, the thickness of the force-free layer, and the location and size of the force-bearing member can be controlled through suitable choice of values for a number of free parameters. The details of a particular force-free design are accurately determined by means of a complex computer procedure. The point by point winding prescription thus obtained can be used to fabricate a coil in which only the small, unavoidable forces due to imprecise location of the conductors are present. (auth)

32272 (NP-14112) THE RANDOM OPTICS OF PARTICLE BEAMS. Technical Report No. 15. Lawrence W. Jones (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). May 1964. Contract Nonr-1224 (23). 15p. (ORA-03106-15-T)

Multiple coulomb scattering, which is generally regarded as an undesirable effect in high-energy physics, can be used to focus or deflect beams of energetic particles. For example, a parallel beam of protons passing through a "lens" of lead, made so that the path length in lead increases as the off-axis distance squared, will produce a focal spot of two or more times the intensity of the beam in the absence of the lens. Other configurations of scattering material can produce a net deflection of the beam. By using a high-Z material and high-energy beams (>1 Bev), multiple scattering effects become relatively more important than energy loss or nuclear interactions. The application of these ideas to handling beams of muons and electrons is also explored. Corresponding effects such as Compton scattering and nuclear diffraction scattering may be used to "focus" gamma and neutron beams. (auth)

32273 (NP-14118) NUCLEAR MAGNETIC RELAXATION IN FERROMAGNETIC TRANSITION METALS. Tôru Moriya (Tokyo Univ. Inst. for Solid State Physics). Feb. 1964. 26p.

The spin-lattice relaxation rates associated with the nuclear magnetic resonance in ferromagnetic transition metals, Fe, Co, and Ni, were studied theoretically. Thermal fluctuation of the internal magnetic field at a nucleus associated with the spin-wave excitation and the individual excitations corresponding to s- and d-bands is considered. The effect of the coupling between the spin waves and the conduction electrons is also considered. The d-band electrons are treated in a tight binding approximation. The predominant nuclear spin relaxation mechanism in all of these metals is shown to come from the fluctuation of the orbital current of the d-band electrons. The other possible mechanisms are shown to make smaller contribution than this by one to two orders of magnitude, except for the Fermi contact interaction of the s-band electrons in Fe and Co, which can possibly make a significant contribution, though not of primary importance. (auth)

32274 (NP-14120) MÖSSBAUER STUDY OF MAGNETIC PROPERTIES IN FERROUS COMPOUNDS. Kazuo Ôno and Atsuko Ito (Tokyo Univ. Inst. for Solid State Physics). Feb. 1964. 33p.

Using the Mössbauer effect of ^{57}Fe, ferrous compounds have been investigated systematically in order to elucidate their magnetic properties from an atomic point of view. Parameters of isomer shifts, quadrupole interactions, and internal magnetic fields at the iron nuclei at various temperatures are listed. It should be notices that the ratio of $eq_z\ (FeSiF_6 \cdot 6H_2O)/eq_z\ (FeCO_3)$ is −1.8, where eq_z is the electric field gradient parallel to the c axis of each crystal. This indicates that the ground state of $FeCO_3$ is an orbital doublet. Some forbidden lines were observed in $Fe_3(PO_4)_2 \cdot 8H_2O$ and $FeC_2O_4 \cdot 2H_2O$ because of the existence of the maximum electric field gradient tensor being perpendicular to the internal magnetic field. (auth)

32275 (ORNL-3652(p.105-31)) MAGNETICS AND SUPERCONDUCTIVITY. (Oak Ridge National Lab., Tenn.).

Studies are presented on: coincident optimization of the power-consumption and field-homogeneity characteristics of magnetic-coil systems; magnetic fields in DCX-1 with superimposed quadrupole fields; the magnetic field of a straight filament segment; quadrupole current sheet arrangements; minimum-B configurations with Fe quadrupoles; the design of magnetometer plasma probes; and the design of microsize Hall probes for superconductivity measurements. (T.F.H.)

32276 (POR-1810) CLOSE-IN AIR BLAST FROM A NUCLEAR DETONATION IN BASALT. L. J. Vortman (Sandia Corp., Albuquerque, N. Mex.). June 1962. Project 1.1b of PROJECT DANNY BOY. Contract AT(29-1)-789. 31p. (WT-1810)

Close-in air blast from the Danny Boy event resulted almost entirely from the ground-shock-induced air blast. Little pressure resulted from venting gases. Consequently, measured pressures were only one-third to one-fourth of those predicted. Ground-shock-induced pressures from the nuclear charge were found to attenuate less rapidly than those from chemical explosives. (auth)

32277 (PR-P-61) PHYSICS DIVISION PROGRESS REPORT, JANUARY 1–MARCH 31, 1964. (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.). 53p. (AECL-1971)

Further studies of the nucleus ^{20}Ne have been carried out combining several techniques. A gamma-ray transition from the 5.63 Mev 3- state to the 0+ ground state has been observed using coincidence and angular correlation techniques with the reaction $^{12}C(^{12}C,\alpha)^{20}Ne$. The transition probability, obtained from the measured partial gamma and alpha widths of the 3- level, shows that this electric octupole radiation is enhanced by a factor of about 7 over the single particle estimate. This implies that the E3 radiation is due to collective vibrations and supports the interpretation of the level as a member of a K = 2 octupole vibration band based on the 4.97 Mev 2- level. Five further levels of ^{20}Ne, decaying predominantly by gamma-ray emission, have been observed using the coincidence technique and angular correlation measurements are being made. A search for high spin levels of ^{20}Ne has continued using the reaction $^{12}C(^{12}C,\alpha)^{20}Ne$ which preferentially populates such levels. Angular correlations between the alpha-particles feeding levels of ^{20}Ne and the decay alpha-particles have been made and lead to spin and parity assignments of 4+ and 7- for the ^{20}Ne levels at 10.57 and 13.39 Mev respectively. The selection of high spin levels has been further enhanced by using a coincidence technique in which the 65 cm magnetic spectrometer was used at 0° to the ^{12}C beam to detect the alpha-particles feeding the ^{20}Ne levels and an annular solid

state counter detected decay alpha-particles emitted close to 180°. A number of levels have been detected with this technique and are being studied further. A lithium-drifted germanium gamma-ray spectrometer has been used to study the gamma rays from levels in ^{20}Ne excited by the reaction $^{19}F(d,n\gamma)^{20}Ne$. The present gamma-ray resolution is about 10 times better than in the previous work with this reaction using pair spectrometers. All of the gamma rays from the above reaction were observed to be Doppler broadened indicating lifetimes of $<10^{-13}$ sec for the corresponding levels in ^{20}Ne. The lithium-drifted germanium spectrometer has become a powerful tool for studies of the complex gamma-ray spectra characteristic of rare-earth nuclides. Some ten different radioactive species covering the region from small or zero to large equilibrium nuclear deformations have been studied. The energies and intensities of the gamma rays have been measured and a number of previously unreported gamma rays have been observed. In a few cases these measurements have been combined with internal conversion beta-ray spectrometer results to give gamma-ray multipolarity assignments. Measurements of the frequency-wave vector dispersion relation for various normal vibration modes in a single crystal of nickel at 296°K have been made recently using the triple axis crystal spectrometer at the NRU reactor. An analysis of the results on the basis of the Born-von Karman theory shows that it is necessary to include fourth neighbor forces to obtain a satisfactory fit to the data. A good fit was also obtained using an axially symmetric model with about the same number of adjustable parameters. A sampling method has been devised and used to compute the frequency distribution function $g(\nu)$ and several of its moments from the Born-von Karman parameters derived above. The function $g(\nu)$ is in agreement with direct but less accurate measurements carried out by Tchernoplekov using a special mixture of nickel isotopes for which the coherent cross section was zero. The moments of $g(\nu)$ are in satisfactory agreement with those derived from precise heat capacity measurements. A number of large detectors are being fabricated by an improved method of lithium drift in germanium. One device with a depletion depth of 4.3 mm and sensitive volume 3.3 cm^3 has been tested and found to have the same high resolution characteristic of the smaller detectors. Several small devices, 10 mm × 2.5 mm, have been made with thin aluminum alloy windows. The resolution of these detectors is also good. Four detectors with moderate volume and good resolution have now been supplied to users in Physics, Chemistry and Reactor Research. (auth)

32278 (R63FPD-130) NEUTRALIZATION OF A 30-KW ION ENGINE ARRAY. George C. Baldwin, Russell N. Edwards, David B. Miller, David C. Prince, Robert A. Scheffer, Ausma Skerbele, and Lewi Tonks (General Electric Co. Missile and Space Div., Cincinnati). Mar. 1963. 107p.

Space charge neutralization effects in ion engines in the 15 to 60 kw range are reviewed in an analytical study to evaluate engine size, mixing phenomena, and interaction with the ambient space plasma. Procedures for ground testing the phenomena, and their use in space are described, and the means of electron generation and injection for several different configurations are outlined. (auth)

32279 (RISÖ-79) COLLISIONS OF MAGNETICALLY DRIVEN SHOCKS. C. T. Chang, G. S. Hansen, and M. Popović (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Feb. 1964. 28p.

The collision of two plane shocks of equal strength was studied by the simultaneous discharge of two identical condenser banks from the two ends of a broad "rail-gun." Photographic and spectroscopic investigations show that the appearance of the reflected luminous fronts and the state of the gas behind them depend largely on the discharge pressure (initial pressure). Measurements of relative line intensities and of the H_β-profile indicate that the gas in the region studied is not in a state of local thermodynamic equilibrium. The appearance of the luminous fronts depends on the polarity of the two condenser banks. When the banks are fired at opposite polarity, the luminous fronts appear to be more irregular; a trapped magnetic field is detected in the region ahead of the incident fronts. (auth)

32280 (UCRL-10644) VIBRATION-ROTATION INTERACTION FACTORS FOR DIATOMIC MOLECULES CALCULATED BY NUMERICAL METHODS. J. K. Cashion (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). July 1963. Contract W-7405-eng-48. 35p.

The influence of vibration-rotation interaction on transition probabilities for diatomic molecules was studied through numerical solution of the Schrödinger radial equation. The numerical method described is readily applicable to any choice of potential and dipole moment functions for the molecule, its accuracy considerably exceeds the requirements of practical applications, and it is very economical in terms of computer-time requirements. Its use is demonstrated in two applications. First, it was used to check the accuracy of the approximate formulas for the F-factors of a rotating Morse oscillator with a linear dipole moment function, derived by Herman, Rothery, and Rubin. It was found that their formulas were very accurate for $\Delta v = 1$ transitions, but that the two formulas given by them for the first and second overtones could introduce errors of several percent at moderate J values. Secondly, quadratic and cubic terms were added to the dipole moment function in order to estimate the sensitivity of F-factors to changes in this function. The results indicate that for all transitions in which $\Delta v > 1$, the higher terms can have considerable significance. For example, F-factors for the lines R(19) and R(20) of the 3-0 band of LiH were changed by factors of more than 3 when the dipole moment function employed was carried from a linear to a cubic approximation in a Taylor's series expansion. (auth)

32281 (UCRL-11213(p.139-53)) INSTRUMENTATION. (California. Univ., Berkeley. Lawrence Radiation Lab.).

An account is given of the 88-inch cyclotron development and operation. Some results are given of high-resolution gamma spectroscopy using Li-drifted Ge detectors. An ion source was designed for surface ionization studies. A sensitive Wheatstone bridge calorimeter was constructed for measuring the energy of very low energy internal conversion electrons emitted in decay of ^{235m}U to ^{235}U. The preparation of diffused and drifted semiconductor detectors is described. The design and use of linear amplifier and gating systems are described. A method was devised for rejecting phototube noise in low-energy x-ray scintillation spectrometry. An improved particle identifier is described for the separation of nuclear reaction products. A system is being developed for recording wavelengths from a spectrum line comparator on magnetic tape. The power supply and current-stepping system of the iron-free beta spectrometer is discussed. A method is given for stabilizing the gain of semiconductor-detector systems. The problem of producing a linear display on the pulse-height analyzer in Mössbauer experiments is considered. An instrument

was developed for stabilizing nuclear spectra recording systems. (D.L.C.)

32282 INFLUENCE OF AN ELECTRIC FIELD ON THE SCINTILLATIONS PRODUCED IN A GAS BY α-PARTICLES. J.-L. Teyssier, D. Blanc, and A. Godeau (Faculte des Sciences, Toulouse). Compt. Rend., 257: 2458-9(1963).

A study was made of the reinforcing effect of an electric field on scintillation in three rare gases: Xe, Ar, and He. The intensity of the fluorescence increased in linear fashion, as a function of E/p. At the same time the energy resolution was improved. This method is used for demonstrating scintillations in air. Excerpta Med., Sect. XXIII, 1: No. 4, (Apr. 1964)

32283 FIZICHESKIE PROBLEMY SPEKTROSKOPII. MATERIALLY 13th SOVESHCHANIYA, LENINGRAD, 4-12 IYUL' 1960. TOM I. (Physics Problems in Spectroscopy. Reports of XIII Conference in Leningrad, 4-12 July, 1960. Volume I). Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 1-476(1962). Moscow, Publishing House of the Academy of Sciences, 1962.

Physical and chemical information obtained from atomic and molecular spectroscopy is discussed. The topics presented include the theory of atomic spectra, oscillator strengths, isotope effects and hyperfine structure, plasma excitation spectra, electron spectra, and vibrational and rotational spectra. Separate abstracts are prepared for 15 of the 188 papers presented. (C.E.S.)

For abstracts of individual papers see: 31458, 31459, 31460, 31461, 31462, 31463, 32761, 32762, 32763, 32764, 32765, 32909, 32910, 32911, and 32912.

32284 EFFECT OF TEMPERATURE ON PHOTO-EXOEMISSION. Joseph F. Young and David J. Williams (Douglas Aircraft Co., Santa Monica, Calif.). J. Appl. Phys., 35: 2279-82(Aug. 1964).

Measurements have been made with a Geiger counter of photo-exoemission from aluminum. The effects of time, temperature, and various adsorbates on the electron emission rate were measured. Adsorption reduces the electron emission rate; ion bombardment within the counter is shown to remove the effects of adsorbed gases. Adsorption of atmospheric gases can explain previously reported decay in emission and temperature effects. (auth)

32285 USE OF ELECTRON PROBES IN THE STUDY OF RECOMBINATION RADIATION. David B. Wittry and David F. Kyser (Univ. of Southern California, Los Angeles). J. Appl. Phys., 35: 2439-42(Aug. 1964).

The electron probe microanalyzer was used to study the local variations in recombination radiation from gallium arsenide. The intensity of recombination radiation from different specimens varies by several orders of magnitude. Local fluctuations are observed which are attributed to surface deformation and to nonuniform distribution of impurities. Within experimental error, the wavelength distribution was indistinguishable from the wavelength distribution from GaAs diodes. (auth)

32286 ON THE SIGNS OF THE HARD SPHERE VIRIAL COEFFICIENTS. Francis H. Ree and William G. Hoover (Univ. of California, Livermore). J. Chem. Phys., 40: 2048-9(Apr. 1, 1964). (UCRL-7519-T(Rev.))

The question of whether or not a central hard potential will give negative virial coefficients is discussed. (C.E.S.)

32287 STOPPING POWER OF ELECTRON GAS AND EQUIPARTITION RULE. Jens Lindhard and Aage Winther (Universitet, Aarhus, Denmark and Universitet, Copenhagen). Kgl. Danske Videnskab. Selskab, Mat.-Fys. Medd., 34: No. 4, 1-21(1964).

In a self-consistent perturbation treatment, the stopping power of matter for fast charged particles is conveniently expressed by means of the dielectric constant. The results were studied for degenerate free electron gases using an explicit expression for the dielectric constant, as derived previously. Approximate results for the stopping at low and high velocities are obtained. At low velocities the stopping is closely proportional to particle velocity, while at high velocities the corrections to the familiar logarithmic dependence on velocity are analogous to atomic shell corrections. The analytic results are compared with direct numerical computations, the results of which are presented in tables and figures. An equipartition rule stating exact equality of the stopping contributions from close collisions and distant resonance collisions is proved. Possible applications of the results to stopping in other media are discussed. (auth)

32288 STOPPING OF 50-kev IONS IN GASES. N. O. Lassen, N. O. Roy Poulsen, G. Sidenius, and Lise Vistisen. Kgl. Danske Videnskab. Selskab, Mat.-Fys. Medd., 34: No. 5, 1-20(1964).

Radioactive ions were passed into a chamber filled with a stopping gas at low pressure. The thermalized ions were collected on the chamber walls by a transverse electric field. Counting revealed information on the charge state, mean range, straggling, and scattering. Measurements were made for ^{24}Na in H_2, D_2, Ne, and A; ^{66}Ga in He, D_2, ^{3}He, ^{4}He, N_2, and Ar; and ^{198}Au in H_2, D_2, Ne, and Ar. (R.E.U.)

32289 EXPERIMENTAL TECHNIQUES IN SPACE PHYSICS RESEARCH. J. H. Johnson and B. J. Farmer (LTV Research Center, Dallas). Nucl. Instr. Methods, 28: 61-9(June 1964).

Techniques were developed for simulating the space electron radiation environment using a 3-Mev Van de Graaff accelerator. Machine modifications and a special boron target allow production of electrons from 100 kev to 11 Mev. Studies of electron interaction cross sections and satellite detector calibration were performed. (auth)

32290 SHAPE AND BEHAVIOR OF WAVE PULSES. P. Gordon (Brandeis Univ., Waltham, Mass.). Nuovo Cimento (10), 32: 1548-60(June 16, 1964).

The shape of pulses resulting from correlated stimulated emissions is studied as a function of the decay time of the process and the bandwidth. The limit imposed by the uncertainty principle on the pulse shape and coherence is derived, and the effect of phase relationships among a small number of emitters is studied. Formulas for fluctuation and coherence are given, and the general effect of pulse shapes is discussed. (auth)

32291 POSITRON ANNIHILATION IN MAGNETISED SINGLE CRYSTALS OF IRON. P. E. Mijnarends and L. Hambro (Institutt for Atomenergi, Kjeller, Norway). Phys. Letters, 10: 272-3(June 15, 1964).

Measurements made on iron by Hanna and Preston, using the positron annihilation angular correlation method to investigate the momentum distribution of the electrons responsible for ferromagnetism, were repeated with a greater accuracy, a better angular resolution, a different normalization procedure, and single crystal samples of 99.8% purity. The results show that the conduction electrons in iron are polarized antiparallel to the 3d electrons. (L.B.S.)

32292 ON THE DERIVATION OF MAXWELL'S EQUATIONS. S. R. De Groot (Univ. of Amsterdam) and J. Vlieger. Phys. Letters, 10: 294-5(June 15, 1964).

The derivation of Maxwell's equations in material media from electron theory is discussed. Equations which take into account the existence of stable atoms (molecules or ions) and which are valid at the atomic level and at the macroscopic level are discussed. (L.B.S.)

32293 INSTABILITIES IN PENNING DISCHARGES. B. Agdur and U. Ternstroem (Royal Inst. of Tech., Stockholm). Phys. Rev. Letters, 13: 5-7(July 6, 1964).

Experimental studies of the generation of electromagnetic energy in the microwave region in a cold-cathode Penning discharge operating at gas pressures of a few microns are described. The frequency differences between adjacent wave maxima were measured, and the phase velocities were calculated. The measurements indicate that the Penning discharge supports slow electromagnetic waves with a phase velocity roughly the same as the velocity of electrons accelerated in a potential drop equal to that between the electrodes. Thus a possible explanation for observed noise radiation is that the slow waves propagating in the discharge get energy from fast electrons. (M.J.T.)

32294 THE RESPONSE OF LAMINAR SKIN FRICTION, TEMPERATURE AND HEAT TRANSFER TO FLUCTUATIONS IN THE STREAM VELOCITY IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. [PART] II. U. Suryaprakasarao (Indian Inst. of Tech., Kharagpur, India). Z. Angew. Math. Mech., 43: 127-33(Mar. 1963).

Exact solutions were obtained for the flow of a viscous incompressible and electrically conducting fluid in the presence of a transverse magnetic field under the following conditions: the fluid flows past an infinite porous flat plate subjected to uniform suction; the free stream velocity oscillates in magnitude but not in direction; the magnetic Reynolds number is equal to the viscous Reynolds number; and the Alfvén velocity is less than the suction velocity. The response of the skin friction, temperature, and heat transfer at the plate to the fluctuating stream was studied for the variations in the frequency of the fluctuating stream. It was found that there is an increase in the magnitudes of the skin friction, wall temperature, and heat flux at the wall due to an increase in the frequency of the fluctuating stream. (auth)

32295 RECIPROCAL PROPERTIES IN MAGNETOGASDYNAMICS. G. Power and Anne Tunbridge (Univ. of Nottingham, Eng.). Z. Angew. Math. Mech., 43: 191-7 (Apr.-May 1963).

The steady, compressible, two-dimensional subsonic flow of a gas with infinite conductivity in a magnetic field parallel to the velocity field was considered, and the equations of motion were transformed to obtain a linear equation of the Chaplygin type. Reciprocal properties were derived, in which every flow pattern corresponded to a simple pressure-density law. From these results an approximation method for solving certain types of magnetohydrodynamic compressible flow problems was deduced, and an example is given showing how the method may be applied. (auth)

32296 MAGNETOHYDRODYNAMIC EFFECTS IN LUBRICATION. J. P. Agarwal (Indian Inst. of Tech., Khargpur, India). Z. Angew. Math. Mech., 43: 181-9 (Apr.-May 1963).

The problem of lubrication under the influence of a uniform magnetic field, when the lubricant is an incompressible and electrically conducting liquid such as mercury, is discussed. Reynolds differential equation for pressure distribution was derived. This was used, in particular, to discuss the case of one-dimensional thrust bearings. Theoretical results indicated the possibility of achieving an increase in load capacity and a decrease in frictional force. (auth)

32297 ON THE STEADY MOTION OF THE HYDROMAGNETIC VISCOUS FLUID AROUND A ROTATING SPHEROID OF SMALL ELLIPTICITY IN THE PRESENCE OF A COAXIAL MAGNETIC FIELD. Milomir M. Stanišić, John O. Hancock, and Bruce H. Fetz (Purdue Univ., Lafayette, Ind.). Z. Angew. Math. Mech., 43: 267-76(June 1963).

A solution is presented for steady motion of a hydromagnetic fluid due to the rotation of a spheroid of small ellipticity about its major axis in the presence of a magnetic field coaxial with the axis of rotation of the spheroid. The results showed that the velocity field consists of two parts, the transient part for $r < a$ in which the velocity increases with increasing of the magnetic field, and the steady part for $r > a$, where the velocity decreases quickly by large increase of the magnetic field. (auth)

32298 THE THEORY OF BRANCHING PROCESSES. Theodore E. Harris. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963. 242p.

A systematic treatment of a theory of mathematical models for the development of populations whose members reproduce and die subject to the laws of chance is presented. The model of Galton and Watson for the propagation of a family of objects all of one type is investigated. The theory is extended to objects of several types and to objects described by continuous variables. The theory is applied to mathematical models for neutron chain reactions, to Markov branching processes with a continuous parameter, age dependent branching processes, and to the electron-photon cascade component of cosmic radiation. (C.E.S.)

32299 ATOMIC AND NUCLEAR PHYSICS. AN INTRODUCTION. T. A. Littlefield and N. Thorley. Princeton, New Jersey, D. Van Nostrand Company, Inc., 1963. 454p. $9.75.

Atomic structure and nuclear composition and properties are described along lines of historical development without resorting to complex mathematics. (R.E.U.)

32300 PHYSIQUE NUCLEAIRE APPLIQUEE. (Applied Nuclear Physics). Robert Guillien. Paris, Editions Eyrolles, 1963. 744p. 87,65 F.

A general treatment of the broad field of nuclear physics is presented. In the first of three sections the discontinuous structure of electricity, radiation, and matter is dealt with. The structure of the atom is discussed as to electron cloud, nucleus, and elementary particles. Section two describes the techniques and apparatus for production and study of elementary particles, and concludes with the ultimate structure of matter. The evolution of thought and the succession of experiments leading to our present knowledge are brought out. In the final section, the essentials of radioactivity, neutronics, and theory and design and use of reactors are covered. (T.R.H.)

32301 PHYSICAL ASPECTS OF IRRADIATION. Recommendations of the International Commission on Radiological Units and Measurements (ICRU). Report 10b 1962. National Bureau of Standards Handbook 85. (National Bureau of Standards, Washington, D. C.). 1964. 106p. $0.70(GPO).

Physical properties of radiations are reviewed. Emphasis is placed on information acquired since 1959 on various techniques for the measurement of absorbed radiation dose and radiation exposure. Characteristics of radiation instruments are reviewed in detail, including radiation standards and methods for neutron measurements. Available data for stopping power ratios and the average energy (W) required to produce an ion pair in a gas are reviewed and modifications for these factors are presented. (C.H.)

32302 MÖSSBAUER EFFECT DATA INDEX. ISSUE 2. A. H. Muir, Jr. and K. J. Ando, comp. Thousand Oaks, California, North American Aviation, Inc., 1964. 196p.

An index to published research results relating to the Mössbauer effect is presented. Experimental results, bibliography sections of theoretical, review, instrumentation, and other publications, and an author index are included. The indexes are grouped by the nuclear transition, source material, and absorber material. (C.E.S.)

32303 MATHEMATICAL METHODS OF PHYSICS. Jon Mathews and R. L. Walker. New York, W. A. Benjamin, Inc., 1964. 485p. $12.50.

Mathematical techniques useful in analyzing problems in physics are discussed. The topics presented include ordinary differential equations, infinite series, evaluation of integrals, integral transforms, applications of complex variables, vectors and matrices, special functions, partial differential equations, eigenfunctions, eigenvalues and Green's function, perturbation theory, integral equations, calculus of variations, numerical methods, probability and statistics, tensor analysis and differential geometry, groups and group representation, and functions of a complex variable. (C.E.S.)

32304 NEW IMPULSE TUBE RESULTS. John R. Banister. 10p. (CONF-471-28)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

Shocks developed by brief discharges in transverse magnetic fields are studied. The method allows the effects of ohmic heating and magnetic driving to be separated, and it can be used to investigate the equation of state of the plasma. The apparatus uses sectored or pierced electrodes to facilitate the diffusion of currents into the discharge region. Shocks in gases having initial pressures down to 1 torr can be studied. Results on Ar are shown. (T.F.H.)

32305 THEORY OF THE NONFULLY DEVELOPED ANODE FALL. C. N. Dunn, C. B. Johnson, and H. J. Oskam. 11p. (CONF-471-23)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The anode fall region of electric discharges is studied theoretically, using the moments of the Boltzmann equation, and assuming Maxwellian distribution functions, constant collision frequency, the absence of ion currents, constant ion temperature, equilibrium conditions, and plane-parallel geometry. (T.F.H.)

Accelerators

32306 (CEA-R-2363) PROJET D'UN ANNEAU DE STOCKAGE A ORSAY POUR ELECTRONS ET POSITRONS D'UNE ENERGIE MAXIMALE DE 450 Mev. (Design of an Annular Storage Device at Orsay for Electrons and Positrons Having a Maximum Energy of 450 Mev). (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accelerateur Lineaire and France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Apr. 1964. 18p. (LAL-1081; CONF-114-28)

From The International Conference on High Energy Accelerators, Dubna, U.S.S.R., Aug. 1963.

The outside design of the machine, and the most important parameters and the expected performances closely connected to the special properties of the ring (very small momentum compaction) are given. Multiturn injection is particularly considered: principle, components, and general characteristics. (auth)

32307 (CEA-R-2425) LA CHEMISE CAPACITIVE DE L'INJECTEUR DE SATURNE. (The Liner of the Saturne Injector). Michel Prome, Maurice Remeur, Guy Rommel, and Roger Vienet (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Apr. 1964. 55p.

Increasing proton-energy injection in the Saclay Proton Synchrotron is described. To realize this type of injection, special equipment is necessary. A description of different elements of that special equipment is given. (auth)

32308 (CERN-64-30(p.31-9)) CONNECTION OF A SMALL COMPUTER TO A PHOTOPRODUCTION EXPERIMENT. R. Alvarez, Z. Bar-yam, D. Garelick, W. Kern, D. Luckey, L. S. Osborne, S. Tazzari (Massachusetts Inst. of Tech., Cambridge); and R. Fessel (Cambridge Electron Accelerator, Mass.).

A 12-bit binary, 1024 word-core storage, 10-μsec cycle computer system to be used on-line for photoproduction experiments at the Cambridge Electron Accelerator is described. The operation of the system before, during, and after data collection is outlined. Results are given for elastic π^0 photoproduction at 1 to 4 Bev. (R.E.U.)

32309 (CERN-64-30(p.245-9)) 1 KM DATALINK FROM PS AREA TO COMPUTER LABORATORY. F. Marciano, C. Mazzari, G. Genova, and H. J. Slettenhaar (European Organization for Nuclear Research, Geneva).

The installation and testing of multicore cables linking the Mercury computer to the Proton Synchrotron are reported. The cables have a delay of 7 μsec at 1 km. (R.E.U.)

32310 (CERN-64-34) DESIGN AND CONSTRUCTION OF QUADRUPOLE LENSES WITH LARGE ELLIPTICAL APERTURE. M. Morpurgo (European Organization for Nuclear Research, Geneva). July 9, 1964. 14p.

The design and construction of a lens with the field in a rectangular quadrupole of the Panofsky type are discussed. (R.E.U.)

32311 (LNF-64/1) EFFETTO DEGLI ERRORI NEGLI ELEMENTI DELLA STRUTTURA MAGNETICA DI UNA MACCHINA ACCELERATRICE A FUNZIONI SEPARATE. (Effects of Errors in the Magnetic Structure Elements of an Alternating Gradient Accelerator). Note No. 231. L. Mango (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 16, 1964. 44p.

The effects of errors in the magnetic structure elements of an accelerator were calculated for three cases: casual and systematic errors and non-linear effects. Some concepts and procedures of the linear theory of alternating-gradient accelerators are reviewed in order to show how the calculations for an imperfect real machine must be defined. Some numerical examples are given for each case. (J.S.R.)

32312 (LNF-64/5) CALCOLI PER L'OTTICA DI TRASPORTO NEL LINAC DI FRASCATI DI POSITRONI

ACCELERATI DA UN'ONDA NON PIANA. (Calculations for the Transport Optics in the Frascati Linac of Positrons Accelerated as a Non-Plane Wave). Note No. 233. E. Ferlenghi and L. Mango (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Mar. 9, 1964. 14p.

Approximations are introduced, which permit the problems of positron transport in the Frascati Linear Accelerator to be handled with greater adherence to reality. The approximations for the geometric acceptance of the optical transport system and for the entity of the electrical field of the accelerating wave (considered non-plane) were improved over previous approximations. (J.S.R.)

32313 (LNF-64/19) VACUUM PROBLEMS OF ELECTRON STORAGE RINGS. Note No. 243. M. Bernardini and L. Malter (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). May 20, 1964. 34p.

The problem of gas evolution in electron-positron storage rings due to synchrotron radiation was explored. The spectral distribution of the radiation was first computed. From this and data on quantum efficiency, it was possible to determine an upper limit to the resultant photoemission from the ring walls. Measurements of the desorption efficiency from stainless steel 304 then made possible a determination of the maximum gas load which could be expected as a result of the synchrotron radiation. This treatment was applied to a planned storage ring to be built at Frascati. From this it appeared that with modest processing the ring walls could be put into a condition such that the gas evolution would have completely acceptable values. The effects of wall temperature and of processing in hydrogen and oxygen upon the desorption efficiency were determined. It was shown that allowing the ring to rest with no circulating beam present creates no problems due to the formation of sorbed films, at least for the material studied. On the basis of the results obtained it is concluded that optimum results would be obtained by the use of materials which are gas free and on which tightly bound layers are formed from the ambient atmosphere. (auth)

32314 (LNF-64/25) SOME CONSIDERATIONS ON THE MAXIMUM AMOUNT OF INFORMATION OBTAINABLE FROM ELECTRON COLLIDING BEAMS EXPERIMENTS. Note No. 245. C. Pellegrini and C. Schaerf (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). May 29, 1964. 4p.

It is shown that to obtain maximum information on the electromagnetic form factors of particles and on the limit of validity of quantum electrodynamics by means of electron-positron colliding beam experiments, it is necessary to perform experiments at certain angles and energies for both e^+-e^- and e^--e^- reactions. (R.E.U.)

32315 (NIRL/R/55) DESIGN OF A HIGH-CURRENT 200-Mev PROTON LINEAR ACCELERATOR. A. Carne and K. Batchelor (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Mar. 1964. 49p.

The cost basis in the design of a proton linear accelerator is given, with particular reference to a 200-Mev, 200-Mc, Injector Linac for a large A.G.S. Practical details of the r-f system and mechanical aspects of the design are considered. Also discussed are tolerances and reliability. (auth)

32316 (NIRL/R/64) THE NIMROD INFLECTOR SYSTEM. R. Billinge (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Apr. 1964. 21p.

A description is given of the design and commissioning of the Nimrod inflector system. The properties of the system were measured, and are in good agreement with those predicted. The use of the system both for normal injection and diagnostic purposes is described. (auth)

32317 (NIRL/R/66) INTERNAL BREAKDOWN IN A SCHNEIDER-TYPE RF ION SOURCE. H. Wroe (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). May 1964. 27p.

Internal breakdown of the Schneider source made its useful life short and unpredictable. The various breakdown phenomena and the attempts to eliminate them, are described. No complete solution to the problem was found, though an improvement was obtained by keeping the r-f discharge as "clean" as possible. The Schneider source was eventually abandoned on the Nimrod Injector. A design, based on the original Thonemann r-f source, free from breakdown limitations, is briefly described. (auth)

32318 (PPAD-512D) AN RF SYSTEM FOR A 12 Gev RAPID CYCLING PROTON AG SYNCHROTRON. J. Riedel (Princeton–Pennsylvania Accelerator, Princeton, N. J.). May 28, 1964. Contract AT(30-1)-2137. 40p.

A systems design and set of detailed r-f calculations for an r-f system for the proposed Japanese synchrotron are presented. Ferrite-tuned drift-tubes will provide 10^6 volts per turn of accelerating voltage. (auth)

32319 (TID-20822) PION FACILITY—A HIGH-ENERGY CYCLOTRON FOR NEGATIVE IONS. (California. Univ., Los Angeles). June 1964. Contract AT(11-1)-34. 244p.

A facility was designed for the production of large fluxes of pions and muons based upon a cyclotron which accelerates negative hydrogen ions to 550 Mev. This design is a result of the determination that the major research objectives of the meson factory could be achieved with a maximum beam energy of 550 Mev. The design has the following features: (a) the duty factor is flexible, offering the possibility of variation from macrostructure 100 per cent, microstructure 80 per cent to macrostructure few per cent, microstructure few per cent; (b) a beam of protons, continuously variable in energy from 200 to 550 Mev, can be extracted along a constant beam line; (c) several beams of differing or the same energy can be extracted simultaneously; (d) at least 200 microamperes of external beam can be produced at full energy without undue activation of the cyclotron itself; and (e) the extracted beam is of high quality. Estimated costs of construction and operation are given. Conceptual design drawings are shown. (auth)

32320 (UCRL-10948) NEUTRINO FLUX ESTIMATE FOR HIGH-ENERGY EXPERIMENTS. Joseph V. Lepore and Robert J. Riddell, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 2, 1963. Contract W-7405-eng-48. 22p.

Using a formula given by Perkins for the distribution of secondary particles produced in high-energy collisions, the neutrino flux to be expected if a beam of high-energy protons impinges on a target is calculated. The resulting simple formula for the flux is used to estimate the flux of neutrinos that may be obtained from a 200-Bev AGS accelerator, operated at various beam energies. Because of the smaller amount of shielding and a greater pulse rate at lower energies, it is seen that the energy of the neutrinos

to be studied will dominate the choice of operating energy. (auth)

32321 (ORNL-3652(p.84-95)) PRODUCTION, ACCELERATION, AND INJECTION OF IONIC AND ATOMIC BEAMS. (Oak Ridge National Lab., Tenn.).

Although 100 ma of H_2^+ beam at 600 kev has been passed through a cone roughly approximating the DCX-2 injection geometry on the test stand, DCX-2 injection is still limited to 50 ma. This limitation has been found to be the result of the slight difference in geometry. Variations in the design of the duoplasmatron ion source have resulted in hydrogen ion beams that are larger (500 ma) and less divergent. (auth)

32322 THE POSSIBLE REGENERATION AND ACCELERATION OF POSITRONS IN A MICROTRON. K. A. Belovintsev and F. P. Denisov. At. Energ. (USSR), 16: 353-4 (Apr. 1964). (In Russian)

The use of high-intensity beams of accelerated positrons for the regeneration of monochromatically annihilated γ-radiation and for interacting opposite electron–positron beams has been considered in England, France, and the USA, employing linear accelerators for the experiments. In order to simplify the experimental equipment, it is proposed to use a microtron for the creation of accelerated positrons. Recent improvements in the technique make it possible to increase the intensity of the positron beams while reducing the cost. The method proposed involves the acceleration of electrons emitted by an injector in the electric field of a high-frequency resonator. In the last orbit, the electron beam passes through magnetic channels; the difference of the lengths of these channels is equal to the distance of the electron injector from the axis of the resonator; the target is placed symmetrically with respect to the injector. Electron–positron pairs are created by the bremsstrahlung. The length of the magnetic channels is so chosen that the positrons emitted by the target reach a phase suitable for further acceleration in the microtron. The electrons and the positrons are accelerated simultaneously and excepting only the injection and the last orbits, all the orbits coincide spatially. The method was experimentally verified on the microtron of the Photomeson Laboratory of the Lebedev Institute of Physics. The coefficient of conversion of the electron beam to the positrons was found to be 3×10^{-4}, at a calculated value of 10^{-3}. The positron beam was monochromatic and possessed satisfactory geometric and angular characteristics. (TTT)

32323 PROPOSALS FOR THE TECHNOLOGICAL IMPROVEMENT OF THE BELT-TYPE GENERATOR. O. Baier and F. Elbel. Kernenergie, 7: 307-10(May 1964). (In German)

Belts currently employed in generators for potentials up to 1.5 millivolt and a few milliamperes are made of approximately 500 millimeter-wide rubberized fabric. The gases in which these belts operate are deleterious to the rubberizing compound. A new charge-transport belt, consisting of nine endless loops of Dederon (a commercial polyamide filament) ribbon, each 15 millimeters wide, was developed. This belt can be operated at a speed of 100 square meter per second and was found to perform satisfactorily. Convenient means were provided in the experimental generator designed for use with the novel belt for replacing the worn-out belts. The construction features involved are described in detail. (OTS)

32324 CALCULATIONS OF THE KLYSTRON TYPE ION BUNCHING. Yoshinao Fujiwara, Kazunori Yuasa, et al. (Konan Univ., Japan). Mem. Konan Univ., Sci. Ser., No. 7, 21-31(Dec. 1963).

The bunching effect of the ion beam was investigated by calculation for the case of the Klystron-type ion bunching system of the five-gap type. From the results of the calculations it is shown that the minimum ion pulse width is obtained by advancing the bunching phase angle relative to the reflector voltage by about 0.2 radians. The pulse duration is expected to be 0.1 and 0.8 ns, and the bunching factor is 172 and 43 when the utilized percentage of the initial ion beam is 10 and 19%, respectively. (auth)

32325 DC PUMPED CYCLOTRON BEAM TUBES USING QUADRIFILAR HELIX. Shigebumi Saito (Tokyo Univ.) and Masamichi Kenmoku. NEC Res. Develop., No. 6, 53-7(Dec. 1963).

Two types of d-c pumped cyclotron beam tube, LD-511D and LD-511E, were developed for high-gain tubes. They have electronic gain of 37 db and 60 db, respectively. LD-511E has two amplifying sections with quadrifilar helix and two electrostatic lenses with three ring-shaped electrodes. At high-gain operation of the tube, the lenses serve as ring amplifier rather than as focusing mechanism of the expanded electron beam. (auth)

32326 THIRD ACCELERATOR CONFERENCE. PROCEEDINGS OF THE THIRD INTERNATIONAL ACCELERATOR CONFERENCE, BOSTON, MASSACHUSETTS, U. S. A., 11-13 NOVEMBER 1963. Kai Siegbahn, ed. Nucl. Instr. Methods, 28: 1-227(June 1964). (CONF-354)

Separate abstracts were prepared for 15 of the 24 papers included. Eight papers were previously abstracted in NSA (18: 6156, 6848, 8969, 14207, 14284, 15319, 20707, and 20708). (D.C.W.)

For abstracts of individual papers see: 32247, 32289, 32327, 32328, 32329, 32331, 32332, 32686, 32775, 32776, 32777, 32778, 32779, 32780, and 32781.

32327 HIGH GRADIENT STUDIES FOR ACCELERATOR SYSTEMS. J. G. Trump (High Voltage Engineering Corp., Burlington, Mass.). Nucl. Instr. Methods, 28: 10-15(June 1964).

Some investigations on acceleration tubes and insulator properties are discussed, which indicate that operating gradients along and within the power and tube column in electrostatic and electromagnetic accelerators can be increased to 3 Mv/m. Only the insulating gradients within the generator and tube column are considered. (D.C.W.)

32328 PRODUCTION OF NEUTRAL HYDROGEN ATOMS WITH ENERGIES OF SOME Mev. Th. Schmidt (Universitat, Freiburg i. B.). Nucl. Instr. Methods, 28: 52-4(June 1964).

The production of high-energy H^0 beams by acceleration and splitting (by a gas) of H_2^+ ions into H and H^+ with subsequent deflection of the charged particles to the wall is discussed. An H^0 beam with an intensity of over 10% of the H_2^+ beam can be obtained. (D.C.W.)

32329 LOW ENERGY ACCELERATOR PROGRAMS IN CANADA. A. E. Litherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 28: 55-9 (June 1964).

The current and future research programs in low-energy nuclear physics are summarized. (D.C.W.)

32330 ULTRAHIGH-CURRENT ION ACCELERATORS. Hans Mark (Univ. of California, Livermore and Univ. of California, Berkeley). Nucl. Instr. Methods, 28: 131-8 (June 1964). (UCRL-7673)

Some recent developments in the production of very intense ion beams are discussed, together with suitable

targets for high-current machines. Scientific and engineering applications of high-current ion accelerators are also discussed. (D.C.W.)

32331 TERMINAL SOURCES. C. H. Goldie (High Voltage Engineering Corp., Burlington, Mass.). Nucl. Instr. Methods, 28: 139-45(June 1964).

A 10-μamp, r-f negative hydrogen ion source designed for the single-ended injector for a three-stage tandem system is described. Its performance and operating characteristics on the bench and in the 5.5-Mv first-stage are discussed. The application of the high power r-f source to the production of He^{2+} beams is also described. (auth)

32332 THE PRODUCTION OF INTENSE NEUTRAL AND NEGATIVE ION BEAMS. P. H. Rose (High Voltage Engineering Corp., Burlington, Mass.). Nucl. Instr. Methods, 28: 146-53(June 1964).

The basic concepts underlying the production of ion beams are reviewed. The properties of the plasma from which the ions are extracted are discussed with respect to their effect on the ion beam. The influence of the positive ion beam emittance and electron attachment on the production of fast neutral particle beams and beams of negative ions is then examined. It is shown that the production of negative ions is best achieved by direct extraction from a plasma, while neutral particle beams must be formed by neutralization of energetic primary positive ion beams. (auth)

32333 ELECTRON BEAM PROFILE MEASUREMENTS. G. E. Fischer (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr., 35: 1081(Aug. 1964).

A technique for rapid measurement of the profile of extracted electron beams was developed, which uses the darkening of ordinary glass microscope slides placed normal to the beam. A linear relation between blackening and exposure was established. At an incident electron energy of 6 Bev, the vertical beam profile had a full-width at half-maximum of 0.32 in. The momentum spread of the beam, when deflected by a bending magnet, can be measured to less than 0.1%. (D.C.W.)

32334 A COAXIAL HIGH-VOLTAGE GUN WITH A MAGNETIC INJECTOR FOR INJECTING ELECTRONS INTO A BETATRON. Zdenek Sedlacek and Pavel Sunka (Plasma Physics Inst., Prague). Slaboprody Obzor, 25: 328-35(1964).

The design of a coaxial high-voltage electron gun for a Czechoslovak 15 megavolt industrial betatron is presented. It is a combination of a slightly divergent Pierce gun with a two-cylinder electrostatic lens. It accelerates electrons up to an energy of 100 kev and furnishes the outgoing beam with the necessary slight convergence. The perveance is adjustable within the limit from zero to $2,10^{-8}$ amperes/volts$^{3/2}$ with approximately a 5 millimeter diameter beam. The good quality of the beam, minimum geometrical aberrations, and current nonhomogeneities were proved by tests. The gun is outside the accelerating space and the beam is introduced into the equilibrium orbit by a channel shielded from the magnetic field by a narrow tube made of a soft magnetic material mounted on the second anode of the gun. The tube is fitted with a winding which compensates the magnetic field and tiny electrostatic deflection plates facilitate the accurate adjustment of the injection angle. This new injection system is expected to enhance the captured charge and consequently the gamma radiation and reduce the spoilage in the manufacturing of accelerating chambers. (OTS)

32335 HIGH INTENSITY ACCELERATORS BELOW 1 Gev. J. Reginald Richardson (Univ. of California, Los Angeles). 20p. (CONF-401-7)

From Institute of Electrical and Electronics Engineers 1964 International Convention, New York, Mar. 1964.

Factors involved in the design of 400- to 1000-Mev high-intensity accelerators, viz. flexibility, costs, possible uses, and beam quality and resolution, are reviewed. The intensities discussed are in the range of 100 to 10,000 times the intensities of presently available accelerators. It is assumed that the beams would be used in nuclear-physics, elementary-particle-physics, and biomedical studies. (T.F.H.)

32336 A METHOD FOR CYCLICAL ACCELERATION OF CHARGED PARTICLES. E. G. Komar. Russian Patent 160,238.

A method is described for cyclic h-f-voltage acceleration of charged particles in the magnetic gap of a cyclotron. By gradually increasing the magnetic intensity from the center to the final orbit, one or several magnetic waves are excited in the magnetic gap of the accelerator, thereby compensating for the relativistic effect and preserving constant particle-rotation frequency with unvarying vertical focusing. The magnetic waves approach the final orbit radially from the center of the accelerator with a velocity equal to the radial component of the velocity of the charged particles. In a variant a traveling magnetic field is superimposed on the permanent magnetic field created in the magnetic gap of the accelerator. (OTS)

Astrophysics and Cosmology

32337 (AD-428086) AN INVESTIGATION OF THE X-RAY EMISSION OF SOLAR FLARES BY THE RADIO ASTRONOMICAL METHOD. Y. I. Neshpor. Translated by Alice B. Dunn, from Izv. Krymsk. Astrofiz. Observ., 29: 152-9(1963). 9p.

The following conclusions are based on a study of the frequency dependence of the attenuation of cosmic radio noise during sudden ionospheric disturbances: (1) the spectral distribution of the x-ray emission intensity of flares varies for each flare, and (2) some solar flares are characterized by an appreciable intensity increase of x-ray emission in the short-wave region. (auth)

32338 RHENIUM AND OSMIUM ABUNDANCES IN TEKTITES. J. F. Lovering and J. W. Morgan (Australian National Univ., Canberra). Geochim. Cosmochim. Acta, 28: 761-8(June 1964).

Rhenium and osmium abundances were determined in two australites, two javaites, one philippinite, two indochinites, two moldavites, and one bediasite by a neutron activation technique. Rhenium abundances ranged from 0.14×10^{-10} to 1.23×10^{-10} g/g and osmium abundances from 2.4×10^{-10} to 13.8×10^{-10}g/g. Measurements of rhenium and osmium abundances in terrestrial acid igneous and sedimentary rocks suggested that either rock types could be suitable parent materials for tektites. (auth)

32339 ZIRCONIUM AND HAFNIUM ABUNDANCES IN METEORITES, TEKTITES AND TERRESTRIAL MATERIALS. J. L. Setser and W. D. Ehmann (Univ. of Kentucky, Lexington). Geochim. Cosmochim. Acta, 28: 769-82(June 1964). (TID-20056)

A total of 41 analyses for both zirconium and hafnium in natural materials are reported using the technique of neu-

tron activation analysis. Included are analyses of 12 chondrites, 4 achonodrites, 4 siderites, 1 meteoritic troilite, 1 meteoritic olivine, 9 tektites, 2 impact glasses, 2 deep-sea sediment cores, 1 obsidian, and standard rocks W-1 and G-1. Cosmic atomic abundances for zirconium of 58 (Si = 10^6) and for hafnium of 0.16 (Si = 10^6) were calculated on the basis of the chondrite analyses. The zirconium-to-hafnium weight ratio for most meteoritic materials was close to 200. This ratio was nearly an order of magnitude smaller for all terrestrial materials analysed. On the basis of this ratio tektites were most similar to the terrestrial materials. Some implications of the data with respect to theories of nucleosynthesis and theories of meteorite and tektite formation are discussed. (auth)

32340 STABLE SILICON ISOTOPE RATIOS IN TEKTITES. David Tilles (Smithsonian Astrophysical Observatory and Harvard College Observatory, Cambridge, Mass.). Geochim. Cosmochim. Acta, 28: 1015-17(June 1964).

Measurements were made of stable silicon isotope ratios in tektites and these measurements compared with other materials. Five out of 6 tektite samples had a spread in silicon isotopic abundance of only 0.33 per mil relative to standard silica compared to the observed natural spread of 5.4 per mil. (M.C.G.)

32341 FREE RADICALS IN THE METEORITE MIGHEI. A. P. Vinogradov, G. P. Vdovykin, and I. N. Marov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 5, 395-8(May 1964). (In Russian)

Free organic radicals in carbonaceous matter of the meteorite Mighei were detected by the method of electron paramagnetic resonance (EPR). Free radicals were established to be present in the carbonaceous matter primarily but not to arise in the process extracting the carbonaceous matter from the meteorite. The formation of free radicals took place either in the evolution process of pre-meteoritic matter or when the meteorite was in space. The presence of free radicals in meteorites allows assumption of the character of development of meteoritic matter. (auth)

32342 POSSIBILITY OF AN ACCELERATED PROCESS OF COLLAPSE OF STARS IN VERY DENSE CENTRE OF A CLUSTER OR A GALAXY. S. M. Ulam and W. E. Walden (Los Alamos Scientific Lab., N. Mex.). Nature, 201: 1202 (Mar. 21, 1964). (LADC-6187)

A group of stars performing Keplerian motions and with initial conditions satisfying the virial theorem was investigated to determine whether after collisions between a few stars the process of encounters becomes accelerated. The calculations were performed by means of the Runge-Kutta method, and results indicate that the process of further collapse becomes accelerated. (C.E.S.)

32343 A THEORETICAL DOMAIN FOR FLARE STARS IN THE H-R DIAGRAM. Arcadio Poveda (Universidad Nacional de Mexico, Mexico City). Nature, 202: 1319-21(June 27, 1964).

The flare activity observed in stars is discussed with respect to solar flares, and the flare stars are assigned a theoretical domain in the Hertzsprung-Russel diagram. (C.E.S.)

32344 THE NEUTRON-STAR HYPOTHESIS OF CELESTIAL X-RAY SOURCES. Minoru Oda (Massachusetts Inst. of Tech., Cambridge). Nature, 202: 1321(June 27, 1964).

The neutron-star hypothesis is applied to the x-ray sources in the Crab Nebula and the constellation Scorpius. (C.E.S.)

32345 REMARKS ON THE VELOCITY OF RADAR WAVES NEAR LARGE MASSES. T. Alvaeger (Univ. of Stockholm) and A. Nilsson. Phys. Letters, 10: 288-90 (June 15, 1964).

The possibility that some effects encountered in the determination of the astronomical unit by radar methods might be due to a gravitational influence on the velocity of radar waves is re-examined. Arguments which show that this possibility is incompatible with observational data are presented. (L.B.S.)

32346 NEUTRINO ASTRONOMY AND INTERMEDIATE BOSONS. John N. Bahcall and Steven C. Frautschi (California Inst. of Tech., Pasadena). Phys. Rev., 135: B788-91(Aug. 10, 1964).

Neutrino fluxes from strong radio sources are estimated, assuming the neutrino-production mechanism: p + p → nucleons + mesons → nucleons + electrons, gamma rays, and neutrinos. The neutrino fluxes calculated on the basis of this mechanism are too small to be easily detected unless there are resonances in neutrino processes associated with the production of intermediate bosons. It is shown that a resonance in the antineutrino-electron system, associated with the usually hypothesized W^- resonance, could be used to test, with standard experimental techniques, whether strong radio sources emit high-energy neutrinos in the quantities estimated. Two kinds of observational tests are described, and counting rates are estimated. Observational tests of the kind proposed would provide important information about the mechanism for production of high-energy electrons in strong radio sources, and the magnetic fields in such sources. Comments concerning other logically possible neutrino resonances are also included. (auth)

32347 THE ABUNDANCES OF IRON AND SILICON IN THE SUN. L. H. Aller, B. J. O'Mara, and S. Little (Univ. of California, Los Angeles). Proc. Natl. Acad. Sci. U. S., 51: 1238-43(June 1964).

The Fe/Si abundance ratio in the sun is calculated, taking into account the singly and doubly ionized species of these elements, as well as the neutral atoms. It is concluded that the Fe/Si and Fe/(Fe group) ratios in the sun are well below those in meteorites. (T.F.H.)

32348 FARADAY ROTATION ON DECAMETRIC RADIO EMISSIONS FROM JUPITER. James W. Warwick and George A. Dulk (Univ. of Colorado, Boulder). Science, 145: 380-3(July 24, 1964).

Some decametric radio emissions from Jupiter observed recently exhibit effects that are attributable to Faraday rotation within the earth's ionosphere. The evidence for the presence of Faraday rotation is presented and its origin is discussed. Identification of the magnetoionic mode in which the emission is generated at Jupiter appears possible although near the limit of accuracy of our present observations. The emission seems to be generated in the extraordinary mode. (auth)

32349 ON LEVI-CIVITA'S THEOREM OF MECHANICAL EQUIVALENCE. Paul Kustaanheimo (Astronomisches Observatorium, Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 28: No. 7, 1-11(1963). (In German)

The correct form of this theorem is deduced and applied to the calculation of the dilatation of the period of orbits with great eccentricity in the general theory of relativity. The amount of this fourth astronomical effect of the general theory of relativity is thus confirmed in a new independent way. (auth)

32350 RADIO ASTRONOMY TODAY. PAPERS DESIGNED TO PRESENT RADIO-ASTRONOMY IN ALL ITS

ASPECTS, GIVEN AT THE JODRELL BANK SUMMER SCHOOL, 1962. H. P. Palmer, R. D. Davies, and M. I. Large, eds. Cambridge, Mass., Harvard University Press, 1963. 252p. $6.00.

Lectures are presented on the radio emission of the sun, planetary emissions, interplanetary radar, techniques in radio astronomy, radio astronomy from space vehicles, computers in radio astronomy, radio telescope design, interstellar matter, galactic hydrogen lines, extragalactic hydrogen lines, galactic magnetic fields, radio emission mechanisms, spectra of radio sources, angular sizes of radio sources, source brightness distribution, non-thermal radio sources, optical identification of radii sources, and cosmological theories. (C.E.S.)

32351 ON THE CALCULATION OF ELECTRON EXCITATION CROSS SECTIONS FOR FORBIDDEN LINES OCCURRING IN GASEOUS NEBULAE. S. J. Czyzak and T. K. Krueger (Aerospace Research Labs., Wright-Patterson AFB, Ohio). p.213-25 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Particularly interesting and important are the ions of the $2p^q$ and $3p^q$ configurations in the study of gaseous nebulae spectra. Since these ions play an important role in the estimation of the physical conditions and chemical composition of a nebula, accurate collisional cross section and the transition probability data are required. A prerequisite are accurate radial wave functions. The calculation of the radial wave functions is reviewed, and the effects of exchange, configuration, and correlation are considered. Calculated transition probabilities for $3p^q$ configuration are considered, comparisons to earlier work are made, and the effect of exchange on these results is discussed. Results of some of the cross section calculations for $3p^q$ configuration are given, and the present status of these calculations is discussed. (auth)

32352 STELLAR INTERIORS. VOLUME SIX. Donald H. Menzel, Prabhu Lal Bhatnagar, and Hari K. Sen. The International Astrophysics Series. New York, John Wiley & Sons, Inc., 1963. 325p.

A brief survey of observational data is presented. Quantum statistics and degenerate matter, gas dynamics, stellar structure, convective and radiative models, white dwarfs, and stellar evolution are discussed. (R.E.U.)

32353 SPACE SCIENCE. Donald P. Le Galley, ed. University of California Engineering and Physical Sciences Extension Series. New York, John Wiley & Sons, Inc., 1963. 685p.

The topics discussed include space exploration, stellar evolution and high energy phenomena in astrophysics, the physics of the sun, the origin and evolution of the solar system, radio exploration of the solar system, exploring the solar system with space probes, dynamics, composition and origin of geomagnetically trapped particles, the dynamics of the outer radiation zone, ring currents, cosmic magnetism, the production and propagation of particles from the sun, cosmic rays, the exosphere, rocket spectroscopy, the surface of the moon, and bioastronautics. Each chapter included an extensive list of references. Separate abstracts are prepared for 11 of the 16 chapters. (C.E.S.)

For abstracts of individual chapters see: 32354, 32355, 32356, 32357, 32358, 32359, 32504, 32687, 32688, 32689, and 32690.

32354 STELLAR EVOLUTION AND HIGH ENERGY PHENOMENA IN ASTROPHYSICS. Jesse L. Greenstein (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). p.58-87 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

A discussion of stellar evolution and the origin of chemical elements, magnetic acceleration processes, lithium stars, contracting stars, the interstellar medium, synchrotron radio-frequency emission, and radio galaxies is presented. (C.E.S.)

32355 THE PHYSICS OF THE SUN—ITS NATURE, STRUCTURE, AND EMISSION PROPERTIES. Leo Goldberg (Harvard Univ., Cambridge, Mass.). p.88-122 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The properties and structure of the solar photosphere, chromosphere, and corona are discussed. The emission properties of solar phenomena such as plages, filaments, prominences, and flares are outlined. (C.E.S.)

32356 RADIO EXPLORATION OF THE SOLAR SYSTEM. Von R. Eshleman (Stanford Univ., N. J.). p.169-99 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The study of the solar system by the techniques of radio and radar astronomy is discussed. The properties of the moon, Venus, Jupiter, and the sun obtained from radio and radar studies are outlined. (C.E.S.)

32357 ROCKET EXPERIMENTS IN COSMIC MAGNETISM AND THEIR SIGNIFICANCE. Charles P. Sonett (National Aeronautics and Space Administration, Washington, D. C.). p.374-426 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The principal results of the direct observation of magnetic fields and plasma in space are reviewed. The properties of astrophysical plasma, the outer atmosphere of the earth, hydromagnetic wave propagation in the magnetosphere, the interplanetary cavity, and cosmic ray data are discussed. (C.E.S.)

32358 THE PRODUCTION AND PROPAGATION OF ENERGETIC PARTICLES FROM THE SUN. John R. Winckler (Univ. of Minnesota, Minneapolis). p.427-65 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The characteristics of solar flares associated with the production of energetic particles and the various methods of measuring these particles near the earth are discussed. The intensity and energy time variations in free space and inside the geomagnetic field are described. Information that can be obtained from these measurements is also discussed. (C.E.S.)

32359 ROCKET SPECTROSCOPY. Herbert Friedman (Naval Research Lab., Washington, D. C.). p.549-629 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The properties of the solar uv and x-ray spectra obtained by means of rocket spectroscopy are discussed. Ultraviolet and x-ray sensors, spectrographic experiments, chromospheric models, x-ray photometry, ultraviolet photometry of the night sky, and orbiting observatories are described. (C.E.S.)

Atomic Physics

Refer also to abstract 32899.

32360 (AWRE-O-17/64) NUMERICAL CALCULATIONS ON HYDROGEN LINE STRENGTHS IN AN ELEC-

TRIC FIELD. D. A. Moody (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1964. 238p.

Some recent numerical calculations of oscillator strengths, transition probabilities, and lifetimes of radiative transitions between levels of hydrogenic atoms split by the weak-field Stark effect are reported. The results encompass all transitions between levels with principal quantum numbers ≤25; because of its bulk only part of this data is presented in the tables. The complete tables are available in the form of microfilm. The numericals were obtained from a Fortran program for IBM 7030. (auth)

32361 (COO-1328-8) OBSERVATION OF ROTATIONAL DE-EXCITATION OF D_2 USING CROSSED MOLECULAR BEAMS. Anthony R. Blythe, Arthur. E. Grosser, and Richard B. Bernstein (Wisconsin. Univ., Madison and Wisconsin. Univ., Madison. Theoretical Chemistry Inst.). June 1, 1964. Contract [AT(11-1)-1328]. 23p. (WIS-TCI-54G)

The collision-induced transition $j = 2 \rightarrow 0$ in ortho-D_2 was observed using a direct kinematic technique. A velocity-selected beam of K atoms was crossed with a cooled, modulated beam of deuterium molecules. Velocity analysis of the K beam scattered through known center-of-mass angles (near 110°) gave direct evidence of recoil arising from inelastic collisions in which the rotational de-excitation $j = 2 \rightarrow 0$ had occurred. (auth)

32362 (LADC-5919) RELATIVISTIC EFFECTS IN THE THOMAS-FERMI ATOM. J. M. Canfield and J. T. Waber (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 13p.

Two methods of applying relativistic corrections to the Thomas-Fermi atom are considered and numerical calculations are discussed. Radial charge distributions calculated from a relativistic Thomas-Fermi equation agree in gross form with those from more complicated self-consistent calculations. Energy eigenvalues for mercury, as determined from the relativistic Thomas-Fermi solution, are compared with other calculated and experimental values. (auth)

32363 ENERGY SPECTRUM OF IONS OBTAINED IN A GLOW DISCHARGE WITH A CYLINDRICAL CATHODE. Jerzy Lis and Jerzy Mielnik. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Polonia, Sect. AA, 17: 15-26(1962).

The spectra of ions produced in glow discharges in air and Ar are measured, using a discharge chamber with cylindrical symmetry. (T.F.H.)

32364 EFFECT OF AN ISOTOPIC IMPURITY ON THE ENERGY FLOW IN A SYSTEM OF ONE-DIMENSIONAL COUPLED HARMONIC OSCILLATORS. Keiko Kobayasi (Nagoya Univ., Japan) and Ei Iti Takizawa. Chinese J. Phys. (Taiwan), 2: 10-22(Apr. 1964).

The effects of an impurity atom on the energy transport in a one-dimensional linear system of coupled harmonic oscillators is investigated by means of the Schrödinger coordinates. The correlation functions of particles in the system are calculated as functions of time, assuming an initial canonical ensemble such that half the system is at temperature T and other half at temperature zero. Thus it is shown that the average kinetic and potential energies of each particle in the infinitely large system approach different stationary values on both sides of the impurity atom, and that the system approaches a stationary state with an energy distribution gap at the impurity site. This result agrees with one obtained previously by means of trigonometric eigenfunctions of the dynamical system. The elements of the position-velocity correlation matrix are also calculated. The energy flow in the large system is derived, and it is shown that even after a sufficiently long time the finite energy flow still exists at every point of the system though there is no temperature gradient at that point. (auth)

32365 ANGULAR MOMENTUM DISTRIBUTIONS IN THE THOMAS-FERMI AND THOMAS-FERMI-DIRAC MODELS OF THE ATOM. Jenn-Lin Hwang (National Taiwan Univ.). Chinese J. Phys. (Taiwan), 2: 28-31(Apr. 1964).

The angular momentum distributions in the Thomas-Fermi and Thomas-Fermi-Dirac models of the atom are calculated by a previously proposed method. The maximum energy $(E_l)_{max}$ for a given orbital angular momentum state is not neglected and is treated as an eigenvalue by the WKB method. The effective central field potentials in terms of the universal approximate Thomas-Fermi function proposed by Latter are utilized. The determination of $(E_l)_{max}$ and, therefore, the number of electrons n_l for a given angular momentum state l is greatly facilitated using the term values computed by Latter. The calculated angular momentum distributions are checked with the diagrams of term values vs Z given by Latter to assure that the proposed method produces no appreciable error. It is found by comparison with the empirical data that the accuracy of the Thomas-Fermi-Dirac model is far better than that of the Thomas-Fermi model. The prediction of the first appearance of the s, p, d, and f electrons by the Thomas-Fermi-Dirac model is almost exact. (auth)

32366 PRODUCTION OF METASTABLE Hg ATOMS BY CHARGE EXCHANGE. Robert W. Rostron (Washington Univ., St. Louis). J. Appl. Phys., 35: 2291-9(Aug. 1964).

Neutral mercury atoms, formed by charge exchange processes between positive mercury ions and mercury vapor atoms, were found to liberate a copious yield of secondary electrons from a metal surface. Values of γ as high as 0.40 were observed. The source of positive ions was the plasma of a mercury arc discharge. Since such a high yield of secondary electrons is not indicative of ground state neutral atoms, the atoms were assumed to be metastable. To test this hypothesis the neutrals were allowed to decay in their flight to the target. A second method of quenching the supposed metastable atoms consisted of admitting minute quantities of H_2 and Ar gas into their flight path. In both cases the secondary emission was reduced by several orders of magnitude thus verifying the metastability hypothesis. The 4.66-, 5.43-, and 9.0 ev metastable states were observed along with a long-lived state having a mean lifetime of 6.0 μsec. As an experimental sidelight of great importance, it was observed that Hg^- ions were formed in the collimated beam of excited neutral atoms. (auth)

32367 MONTE CARLO RANGE CALCULATIONS FOR A THOMAS-FERMI POTENTIAL. Ordean S. Oen and Mark T. Robinson (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 35: 2515-21(Aug. 1964).

Earlier Monte Carlo calculations of the ranges of atoms having energies from 1 to 100 kev, slowing down in a random solid through binary elastic collisions, were extended by using a Thomas–Fermi potential to represent the interaction between the moving atom and a lattice atom. The screening radius of the potential is that derived by Firsov. The calculations were made for a wide variety of target-

to-projectile mass ratios. Except for the highest energies, the calculated ranges are considerably shorter than those found previously using the exponentially screened Coulomb potential. Most of the experimental range data lie between the range curves calculated for these two potentials, although the Thomas–Fermi potential gives somewhat better over-all agreement. The shapes of the calculated range distributions give close agreement with those found by experiment in amorphous solids. Average ranges calculated by integrating the reciprocal of the stopping power agree fairly well with these Monte Carlo calculations, especially when the mass of the slowing-down atom is large compared to that of a lattice atom. (auth)

32368 EFFECT OF COLLISION FOCUSING ON MONOCRYSTALLINE SPUTTERING YIELD THEORY. Harold P. Smith, Jr. (Univ. of California, Berkeley). J. Appl. Phys., 35: 2522-4(Aug. 1964).

An improvement is offered to the theoretical model of monocrystalline sputtering yield proposed by Southern, Willis, and Robinson. The collision focusing effect, not considered in the original model, is included by multiplication of a momentum conductance factor which removes the dependence upon first collision depth and substitutes the effect of momentum propagation along the close-packed directions from the point of the first collision to the crystal surface. The inclusion of this factor yields better agreement with the data. (auth)

32369 1- TO 10-kev COLLISIONAL DETACHMENT CROSS SECTIONS FOR O^- AND O_2^- ON ARGON AND NITROGEN. John P. Doering (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 41: 1164-5(Aug. 15, 1964). (LADC-6305)

Investigations were made on the collisional detachment cross sections for O^- and O_2^- in Ar and N in the hope that they would be of use in the design of negative ion collision experiments where collisional detachment from the background gas is a prime source of noise. Results in the case of O^- on Ar was gratifying. However, disagreement between two experiments in the case of O^- on N_2 is not understood. Nevertheless, the results are regarded as total cross sections for electron detachment in Ar and N. (P.C.H.)

32370 HYPERFINE STRUCTURE OF THE ATOMIC SPECTRUM AND THE NUCLEAR MOMENTS OF THE THORIUM-229 ISOTOPE. V. N. Egorov. Opt. i. Spektroskopiya, 16: 549-54(Apr. 1964).

The hyperfine structure of the atomic spectrum of thorium-229 was studied. The spin ($I = 5/2$) was determined from the lines given in the hyperfine structure and an estimation of the magnetic ($\mu = (0.41 \pm 0.01)\ \mu_{nucleus}$) and the quadrupole ($Q \approx 4.6 \cdot 10^{-24}$ cm^2) moments of the thorium-229 nucleus is presented. The nuclear deformation coefficient for thorium-229 was also estimated, $\alpha \approx 0.21$. (OTS)

32371 EXCITATION OF MOLECULAR VIBRATIONS BY FAST ELECTRONS. H. Boersch, J. Geiger, and W. Stickel (Technische Universität, Berlin). Phys. Letters, 10: 285-6(June 15, 1964). (In German)

The excitation of vibrational levels of H_2 and CO_2 molecules was investigated, using an analogy with light absorption. No direct excitation of the vibrational levels was observed with 25-kev electrons in the energy-loss spectrum of H_2. The energy-loss spectrum of CO_2 in the region of low energy shows two lines with maxima at 0.083 and 0.292 ev after correction for the background, which corresponds to the excitation of the deformation-vibration and the antisymmetrical valence-vibration respectively. (L.B.S.)

32372 WAVE TREATMENT OF ELECTRON CAPTURE IN $H^+ - H$ COLLISIONS. F. J. Smith (Queen's Univ., Belfast). Phys. Letters, 10: 290-1(June 15, 1964).

The electron capture probability in $H^+ + H$ collisions was obtained by an approximate method, combining the results of Bates and Williams with the two-state wave treatment of Massey and Smith. Comparison of the calculated probabilities with the experimental results is shown. (L.B.S.)

32373 EXCLUSION OF PARITY UNFAVORED TRANSITIONS IN FORWARD SCATTERING COLLISIONS. U. Fano (National Bureau of Standards, Washington, D. C.). Phys. Rev., 135: B863-4(Aug. 10, 1964).

Functions $Y_{ll'LM}(\hat{k},\hat{k}')$ of the directions of incidence and scattering are considered which transform like spherical harmonics Y_{LM} and are linear combinations of products $Y_{lm}(\hat{k})Y_{l'm'}(\hat{k}')$. When they are parity unfavored ($l + l' - L$ odd), these functions vanish for $\hat{k} \cdot \hat{k} = \pm 1$. This property accounts for selection rules pointed out previously for particular types of collision. (auth)

32374 STARK SHIFT OF THE HYDROGEN HYPERFINE SEPARATION. E. Norval Fortson, Daniel Kleppner, and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 13: 22-3(July 6, 1964).

The effect of external electric fields on the hyperfine structure of atomic hydrogen was measured using the atomic hydrogen maser. A frequency shift of $-(6.7 \pm 0.4) \times 10^{-5}\ E^2$ cps/(esu)^2 was obtained. This value agrees substantially with that from the Schwartz calculation. An unsuccessful search was made for a term in the Stark shift which is linear in E. (M.J.T.)

32375 DIRECT MEASUREMENT OF ATOMIC LIFETIMES: HELIUM. T. M. Holzberlein (Univ. of Oklahoma, Norman). Rev. Sci. Instr., 35: 1041-6(Aug. 1964).

A complete system for direct observation of decay of excited states is described. It comprises an inverted triode excitation tube with coaxial symmetry, capable of responding to an electrical cutoff with a risetime of about 10 nsec. Tests in helium have shown that it can give reliable lifetimes at least as small as 30 nsec. (auth)

32376 VIBRATIONS OF FINITE ONE-DIMENSIONAL CHAINS. P. M. Mathews (Univ. of Madras). Z. Angew. Math. Mech., 43: 485-92(Oct.-Nov. 1963).

It is shown that by introducing generating functions for the vibration amplitudes of atoms in a linear chain, determination of the normal modes and proper frequencies of the chain can be reduced to a purely algebraic problem. The method is illustrated by applying it to the study of the vibrations of a finite diatomic linear chain of atoms interacting through nearest-neighbor Hooke's law forces. The results are discussed and compared with earlier work on the problem. The possibility of extension of the method to more general situations is indicated. (auth)

32377 OPTICHESKIE SPEKTRY ATOMOV. (Optical Spectra of Atoms). E. Frish. Moscow-Leningrad, State Publishing House of Physics and Mathematics Literature, 1963. 640p.

The foundations of the Bohr theory and the vector model of the atom are reviewed. Spectra of atoms and ions with one, two, or more valence electrons are considered. The periodic system of elements is discussed in relation to atomic spectra. The effect of external magnetic and electric fields on atomic spectra is described and examples are given. Intensity, width, and fine structure of spectral lines are discussed extensively. Sample spectra pictures and tables of atomic and spectral data and constants are presented. (M.J.T.)

32378 ATOMIC COLLISION PROCESSES. The Proceedings of the Third International Conference on the Physics of Electronic and Atomic Collisions, University College, London, 22nd-26th July, 1963. M. R. C. McDowell, ed. Amsterdam, North-Holland Publishing Company, 1964. 1176p. fl26; £12,12s; $35.-. (CONF-186)

Slow electron scattering by atoms, resonances, polarization of radiation emitted on electron impact, excitation and ionization atoms by electron impact, electron-molecular collisions, recombination, negative ions, photo processes, elastic and inelastic heavy particle collisions, and collisions with molecules are discussed. Separate abstracts are prepared for 123 of the 134 papers presented. Abstracts of 11 papers previously appeared in NSA (17: 7263, 27950, 32731, 36376, 39716, 39725, and 41629 and 18: 2540, 16695, and 25377) and RDA (7: 183). (C.E.S.)

For abstracts of individual papers see: 31538, 31539, 31640, 32351, 32379, 32380, 32381, 32382, 32383, 32384, 32385, 32386, 32387, 32388, 32389, 32390, 32391, 32392, 32393, 32394, 32395, 32396, 32397, 32398, 32399, 32400, 32401, 32402, 32403, 32404, 32405, 32406, 32407, 32408, 32409, 32410, 32411, 32412, 32413, 32414, 32415, 32416, 32417, 32418, 32419, 32420, 32421, 32422, 32423, 32424, 32425, 32426, 32427, 32428, 32429, 32430, 32431, 32432, 32433, 32434, 32435, 32436, 32437, 32438, 32439, 32440, 32441, 32442, 32443, 32444, 32445, 32446, 32447, 32448, 32449, 32450, 32451, 32452, 32453, 32454, 32455, 32456, 32457, 32458, 32459, 32460, 32461, 32462, 32463, 32464, 32465, 32466, 32467, 32468, 32469, 32470, 32471, 32472, 32473, 32474, 32475, 32476, 32477, 32478, 32479, 32480, 32481, 32482, 32483, 32484, 32485, 32486, 32487, 32488, 32489, 32490, 32491, 32492, 32493, 32494, 32495, 32496, and 32875.

32379 THE PRESENT STATE OF THE STUDY OF ATOMIC COLLISIONS. H. S. W. Massey (University Coll., London). p.3-13 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The present state of atomic collision study is reviewed. Available generalizations of theoretical methods for central potential problems to more complex situations are tabulated. Further scope for theoretical and experimental work is surveyed. (auth)

32380 THE EXCHANGE POLARISATION APPROXIMATION FOR THE ELASTIC SCATTERING OF SLOW ELECTRONS AND POSITRONS BY ATOMS AND IONS: ELECTRON SCATTERING BY HELIUM IONS. I. H. Sloan and H. S. W. Massey (University Coll., London). p.14-15 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Phase shifts for the elastic scattering of electrons by helium ions were calculated in the exchange polarization approximation, and compared with those predicted by the quantum defect method. Generally the calculated low energy phase shifts are superior to exchange approximation phase shifts (especially for d-waves), but for triplet scattering the effect of polarization is over-emphasized. The full polarized orbital approximation yields further improvement for s- and d-waves, but the p-wave shifts are worse. This is consistent with the fact that the polarized orbital phase shifts are associated with a stationary principle, which fails for p-wave scattering; the latter disability applies also to p-wave electron-hydrogen scattering. (auth)

32381 ELASTIC SCATTERING OF ELECTRONS BY THE MANY-ELECTRON ATOM. E. Bauer and H. N. Browne (Michelson Lab., China Lake, Calif.). p.16-27 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Effective potentials for exchange and correlation are derived by drastically simplifying the Hartree-Fock equations for the system (atom + free electron) and applying some ideas from the theory of the free electron gas. The resulting uncoupled differential equations for the free electron partial waves are solved numerically. Total and differential elastic scattering cross sections are computed for H, He, Ne, Ar, Kr, Zn, Li, Na, K, N, and O. Good agreement is found in general with other semi-empirical or more elaborate calculations and with experiment. (auth)

32382 ELASTIC SCATTERING OF LOW ENERGY ELECTRONS IN THE THOMAS-FERMI THEORY. T. Tietz (Univ. of Lodz, Poland). p.28-30 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The elastic scattering properties of the Thomas-Fermi atom for low energy electrons were investigated. An analytical formula for the cross section is obtained from the radial Schroedinger equation by means of the Thomas-Fermi potential. (C.E.S.)

32383 PSEUDOPOTENTIALS IN THE THEORY OF ELECTRON SCATTERING. R. Gáspár (Kossuth Lajos Univ., Debrecen, Hungary). p.31-4 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The form of the pseudopotential in the many-body theory of electron scattering is derived from the Hartree-Fock approximation, and the importance of the pseudopotential in scattering theory is discussed. (C.E.S.)

32384 TREATMENT OF EXCHANGE IN SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. J. F. Walker and M. Bolsterli (Univ. of Minnesota, Minneapolis). p.35-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The single particle equations for many-particle systems that were derived previously are applied to the system consisting of two electrons and a proton in an attempt to recalculate the H^- bound state and e-H scattering. The angular dependence of the invariant functions is found and used to obtain the coupled equations for the radial functions. The exchange scattering amplitude is shown to be simply obtained from the direct wave function, so that the asymptotic form of the radial functions is just that of the asymptotic direct wave function. (auth)

32385 REARRANGEMENT COLLISIONS: ELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. K. L. Bell, B. L. Moiseiwitsch, and D. B. Shields (Queen's Univ., Belfast). p.40-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The partial cross sections for the elastic scattering of electrons by helium atoms are calculated using the second Born approximation together with a first order exchange approximation. Satisfactory agreement is obtained with the results of numerical integration except in the case of the zero order partial wave for which only qualitative agreement is found, mainly due to the overestimation of the role of distortion by the second Born approximation. The theoretical values of the total elastic cross section, obtained by summing the best available partial cross section values, are in satisfactory accord with experiment

provided that the total cross section data of Normand are increased by about 25 per cent. (auth)

32386 THE EFFECT OF POLARIZATION ON THE ANGULAR DISTRIBUTION OF ELECTRONS SCATTERED BY ATOMS. S. P. Khare and B. L. Moiseiwitsch (Queen's Univ., Belfast). p.49-52 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

An investigation was carried out on the contribution of polarization to the sharp increase in the differential cross section at small angles of scattering for electrons elastically scattered by atomic systems. (auth)

32387 ABSOLUTE MEASUREMENT OF TOTAL CROSS SECTIONS FOR THE SCATTERING OF LOW ENERGY ELECTRONS BY ARGON, NITROGEN, AND OXYGEN. W. Aberth, G. Sunshine, and B. Bederson (New York Univ., New York). p.53-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

An atom beam recoil technique was used to measure absolute total electron scattering cross sections for argon and molecular oxygen and nitrogen in the energy range of 1 to 25 ev. The atom beam is cross-fired by an electron beam and the resultant attenuation of the atom beam is measured. Since both the total beam and the scattered component of the beam are measured by the same detection and amplification system, it is possible to determine absolute cross sections without requiring knowledge of the beam detection efficiency of the overall gain of the amplification system. The atom beam was detected by means of a beam ionizing electron gun. A narrow band phase sensitive amplifier, coupled with an integrator, recorded the final signal. Integration times of 10 to 30 minutes enabled attenuations of less than one ten thousandth of the full beam to be detected. The cross sections appear to be somewhat larger than those of early Ramsauer-type measurements, but agree well qualitatively. (auth)

32388 MEASUREMENT OF THE ELASTIC COLLISION CROSS SECTION OF LOW ENERGY ELECTRONS WITH CESIUM ATOMS USING ELECTRON-CYCLOTRON RESONANCE. R. G. Meyerand, Jr., and R. K. Flavin (United Aircraft Corp., East Hartford, Conn.). p.59-71 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The collision frequency for momentum transfer of low energy electrons with cesium atoms was determined from measurements of the microwave cyclotron resonance absorption and radiation spectra of a cesium plasma in a d-c magnetic field. The collision cross section for electrons with cesium atoms was determined to vary from 1150 to 1500 P_c at energies of 0.05 and 0.10 ev, respectively, with a maximum cross section of 1900 P_c at 0.065 ev. (auth)

32389 LOW-ENERGY ELECTRON SCATTERING BY MANY ELECTRON ATOMS. J. O. Porteus (Michelson Lab., China Lake, Calif.). p.72-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The differential elastic scattering of electrons by argon gas was investigated in the energy range 75 to 500 ev at angles of 4 to 160 degrees. The inelastic scattering was also investigated at angles of 4 to 10 degrees from the forward direction. Electron energies measured by the retarding field method were differentiated and corrected for energy spread of the incident beam by an optimized method developed for spectroscopic applications. Results are compared with other measurements and with recent calculations. (auth)

32390 THE APPLICATION OF THE VARIATIONAL METHOD TO THE ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOM. F. B. Malik (Atomic Energy Centre, Lahore, Pakistan). p.80-5 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A recently proposed variational method which modifies the Hulthen-Kohn variational methods, so that they become equivalent, was applied to the elastic scattering of S-wave electrons by hydrogen. The same trial wave function as used by Schwartz, was used with 7, 13, 34, and 50 parameters. As predicted, the tangent of the phase shift calculated in this way is free of singularities observed by Schwartz who applied the simple Kohn's procedure. The results are close to Schwartz's results. (auth)

32391 RESONANCES AND REGGE POLES IN e^--H SCATTERING. P. G. Purke (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and K. Smith. p.89-97 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

An investigation of the sharp resonances in the e^--H elastic scattering cross section, below the threshold for excitation of the second quantum level was carried out using two methods of approach. The close coupled 1s–2s–2p equations were solved in the neighborhood of some of these resonances. Certain new resonances were found, in particular a ^1S resonance at approximately 1.75 ev. Secondly the connection of these resonances with Regge trajectories is being considered. The Regge pole formalism provides a convenient way of enumerating these resonances as well as displaying many of their properties. As an aid to this latter investigation a method was developed for calculating the Regge trajectories in the 1s–2s close coupling approximation neglecting exchange. This model is expected to show many of the features of an exact solution of the e^--H problem. (auth)

32392 THE THEORY OF THE NARROW RESONANCES IN THE SCATTERING OF ELECTRONS BY HYDROGEN. A. Herzenberg, K. L. Kwok and F. Mandl (Univ. of Manchester, Eng.). p.98-106 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The application of a modified Kapur-Peierls resonance formalism to electron scattering by atoms leads to narrow levels for resonance states which are energetically unable to decay to a state of the residual atom of which they contain a substantial component. The narrow resonance, at about 10 ev, in the $^1S_0$ state of the electron/atomic hydrogen system is explained in this way. In the Kapur-Peierls formalism, configuration space is divided into internal and external regions. Two effects of this division are considered. The potential acting in the external region leads to a polarization effect for which a general perturbation theory was derived. The contribution to the potential scattering term, due to a single resonance state, is estimated variationally. (auth)

32393 STRUCTURE OF ELECTRON-HYDROGEN RESONANCES JUST BELOW THE INELASTIC THRESHOLD. A. Temkin (Goddard Space Flight Center, Greenbelt, Md.). p.107-13 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A revised calculation of the relative s plus p problem (the first order problem of the nonadiabatic theory) for the singlet S-wave e-H scattering is carried out. The previous zero-th order solution is used for numerically integrating the coupled set of partial differential equations iteratively. The equations are integrated to twenty Bohr radii, and the iterations were carried through three equations. It is con-

cluded that the one resonance of the zero-th order (relative s) resonance increased to two resonances in accord with previous arguments. (auth)

32394 THE EXCITATION OF HELIUM BY ELECTRON IMPACT. R. Marriott (General Dynamics/Astronautics, San Diego, Calif.). p.114-23 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A numerical method was employed for the calculation of all significant partial cross sections for elastic and inelastic collisions of electrons with helium. Explicit allowance was made for electron exchange and all coupling terms between the $He(1^1S)^2$, $He(1S)(2^3S)$ and $He(1S)(2^1S)$ states were retained. Properly orthogonal, approximate analytic wave functions were used to represent these atomic states. Calculations were carried out for electron energies from 20–30 ev. The calculated cross sections for elastic collision with the ground state agree well with experiment. The calculated triplet metastable excitation cross section is found to be 3 times that observed, but indicates correctly a maximum below 20.6 ev. The calculated singlet excitation cross section is within 1.5 times that observed. However, in this case although the zero order partial cross section exhibits a maximum at 22 ev, the first order partial cross section dominates and the total cross section does not show the observed threshold peak. (auth)

32395 RESONANCES IN THE ELASTIC SCATTERING OF ELECTRONS ON ATOMS AND MOLECULES. G. J. Schulz (Westinghouse Electric Corp., Pittsburgh). p.124-7 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A sharp resonance in the elastic scattering of electrons on helium and neon, below the energy of the first electronically excited state was observed. The experiment consists of crossing an electron beam with a half-width of 0.060 ev with an atomic beam and observing electrons scattered at a fixed angle (72 degrees). The observed dip in the cross section of helium at 19.3 ± 0.1 ev is 14% with a half-width of 0.060 ev. This half width is instrumental and thus the true width is narrower. This corresponds to a lifetime of the state larger than $\sim 10^{-14}$ sec. In neon the dip is of the order of 3%. No resonance was observed in argon. The resonance scattering is caused by a compound state of He, i.e. He^-. Resonances in the elastic scattering of N_2 were also observed. (auth)

32396 ANOMALOUS TRANSMISSION OF RARE GASES FOR ELECTRONS OF SUB-EXCITATION ENERGIES. J. Arol Simpson (National Bureau of Standards, Washington, D. C.). p.128-34 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Electrons of variable energy ($\Delta E_{\frac{1}{2}}$ ~0.05 ev) are passed through a chamber containing rare gas at a pressure of some microns. Electrons that are deflected less than 40 mrad are energy-analyzed (resolution ~0.05 ev) and collected. Two types of transmission anomalies, with energy widths essentially instrumental, are observed at energies below those necessary to excite the atom. The first, in He at 19.1 ± 0.1 ev, is an enhanced transmission followed by a decrease in a typical dispersion line shape. The second anomaly in Ne at 15.9 ± 0.15 ev, is not so strong and has a more complicated structure consisting of a doublet (~0.1 ev separation). Both components are sharp decreases in transmission without dispersion line shape. A brief description of the apparatus is included. (auth)

32397 THE EXCITATION AND IONIZATION OF ATOMS BY ELECTRON IMPACT. D. W. O. Heddle and M. J. Seaton (University Coll., London). p.137-62 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A review of experimental and theoretical investigations on electron-atom collision problems involving excitation and ionization is presented. A bibliography of 201 references is included. (C.E.S.)

32398 ABSOLUTE ELECTRON EXCITATION FUNCTIONS OF HELIUM AND THEIR PRESSURE DEPENDENCE. R. M. St. John and C. C. Lin (Univ. of Okalhoma, Norman). p.163-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Absolute values of cross sections for excitation of helium atoms by electron impact were determined for electron energies from 20 to 500 ev. Excitation to the $4\ ^1S$, $5\ ^1S$, $6\ ^1S$, $3\ ^1P$, $4\ ^1P$, $4\ ^1D$, $5\ ^1D$, $6\ ^1D$, $4\ ^3S$, $5\ ^3S$, $3\ ^3P$, $3\ ^3D$, $4\ ^3D$, $5\ ^3D$, and the $6\ ^3D$ states was observed. Helium pressures ranged from 4×10^{-4} to 2×10^{-1} torr. Imprisonment of resonance radiation and excitation transfer are not effective at lower pressures, but are at the higher pressures, causing a gradual change in some of the apparent excitation functions with pressure change. All light intensity measurements were made by observation of radiation emitted at 90° relative to the electron beam. These data were processed and recorded by an electronic, continuous readout system. Corrections for polarization of the emitted light are made for the $3\ ^1P$ case by use of helium polarization data. (auth)

32399 EXCITATION AND POLARIZATION IN HELIUM. D. W. O. Heddle and R. G. Keesing (University Coll., London). p.179-82 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Observations are reported of excitation close to the $4\ ^1D$ threshold. The structure observed with moderate energy resolution is discussed and compared with previous measurements. (auth)

32400 CALCULATIONS FOR EXCITATION OF THE M SHELL OF H NEAR THE THRESHOLD. W. Eissner (Universitat, Tubingen, Ger.). p.183-90 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The general formalism of the partial wave theory of electron-hydrogen atom collisions, developed by Percival and Seaton, is specialized to the excitation of the M shell from the ground state, when calculating in the approximation of the distorted wave method including exchange (EDW). In special cases the partial cross sections $q_{l_z^2}(m_l)$ are compared with those calculated in Born-Oppenheimer (BO) and distorted wave approximation without exchange (DW). It is an improvement to BO when calculating the exchange terms with the DW solutions. For an estimate of the distortion to be expected it is sufficient to calculate the phase shifts in a Born-Oppenheimer approximation. These values are compared with those resulting from EDW. The total cross sections $Q^2(m_l)$, which dominate at low energies, are graphically summarized. (auth)

32401 INELASTIC ELECTRON SCATTERING FROM RARE GASES; DETERMINATION OF OSCILLATOR STRENGTHS IN THE CONTINUUM. C. E. Kuyatt and J. Arol Simpson (National Bureau of Standards, Washington, D. C.). p.191-200 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The inelastic scattering of 500–1000 ev electrons from the rare gases was measured for small angle collisions

and energy losses to 100 ev. Approximate relative oscillator strengths for continuum excitaticns of helium and neon were derived from the forward scattering intensities. The results in helium are in good agreement with the latest ultraviolet measurements and with calculations. In the case of neon, previous experiments and calculations differ considerably. The results agree well with the most recent ultraviolet measurements, except that the electron measurements do not show a sharp L_1 ionization edge. This difference can probably be attributed to the effect of preionization lines with a resonance shape which was recently observed. (auth)

32402 OBSERVATIONS ON THE (1s2s2p) $^4P_{\frac{5}{2}}$ METASTABLE STATE IN LITHIUM. P. Feldman and R. Novick (Columbia Univ., New York). p.201-10 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The (1s2s2p) $^4P_{\frac{5}{2}}$ configuration in He^- and Li is metastable against radiation and auto-ionization via the Coulomb interaction. Lithium atoms in this state can be produced by exchange excitation (energy = 56 ev) of ground state Li atoms. A neutral lithium beam was bombarded with low energy electrons and ions resulting from the decay of metastable atoms were collected 3 cm from the source. The excitation function, production cross section ($\sigma \sim 10^{-19}$ cm^2), and the lifetime ($\tau = 5.1 \pm 1$ μsec) were measured. A theoretical estimate of the probability of autoionization resulting from the spin-spin interaction gives a lifetime of 16 μsec. (auth)

32403 FURTHER DEVELOPMENT OF CLASSICAL THEORY OF ATOMIC COLLISIONS. M. Gryzinski (Inst. for Nuclear Research, Polish Academy of Sciences, Swierk). p.226-36 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

On the basis of the relations previously published for two-body and Coulomb collisions simple formulas describing various physical processes such as: ionization, excitation, exchange process, stopping power, and inelastic scattering are given. It is shown that the continuous velocity distribution for atomic electrons has to be assumed to get the right asymptotic cross sections, the presence of logarithmic term in the ionization cross section, as well as to explain some other different phenomena; continuous decrease of the ionization cross section for heavy particles at low energies. The influence of the positively charged nucleus on the collision process with atomic electrons has also been taken into account in some cases. For example, it is responsible for the exchange process and, in consequence, for the different nature of excitation of singlet and triplet lines. The two-body approximation applied to the scattering problem, in the case of inelastic processes, also gives the right results if the continuous momentum distribution of atomic electrons is taken into account. The diffraction pattern of particles scattered inelastically by atomic systems can also be explained on the basis of corpuscular mechanics; this is due to discrete electron energy states of the scatterer as well as to the anisotropic velocity distribution of its electrons. In view of the simple mathematical formalism, it was possible to give many numerical results. (auth)

32404 THE SEMI-CLASSICAL TREATMENT OF THE EXCITATION AND IONIZATION OF ATOMS AND POSITIVE IONS BY ELECTRON IMPACT. A. Burgess (New York Univ., New York). p.237-42 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The impact parameter method is valid for distances of closest approach, ρ, large compared with the atomic radius. For ionizing collisions important contributions come from smaller values of ρ, particularly near threshold. These contributions are calculated using a classical treatment similar to that of Thomson, but with allowance for the orbital motion of the atomic electron and for the possible exchange of colliding and atomic electrons. The contributions from larger values of ρ, which dominate at higher energies, are calculated using the impact parameter method. The ionization cross sections thus obtained have the correct behavior both at high and at low energies and are in quite good agreement with experiment and with quantal calculations. The effects of exchange are reproduced surprisingly well. (auth)

32405 ON ONE MODEL FOR THE CALCULATION OF EXCITATION CROSS SECTIONS FOR ATOMS. L. Presnyakov, I. Sobelman, and L. Vainshtein (Lebedev Inst. of Physics, Moscow). p.243-52 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Most methods of calculating electron impact excitation cross sections give too much weight to the incident electron-nucleus interaction. Attention should be directed primarily to the incident electron's interaction with the electrons of the target system, as in the impulse approximation. A somewhat similar approximation for the case of atomic hydrogen was studied. The wave function $\Psi(r_1,r_2)$ was taken to have the form $\phi(r_1)g(r_1,r_2)$ where $\phi(r_1)$ is the unperturbed target wave function and $g(r_1,r_2)$ satisfies the Schrödinger equation for the mutual interaction of the electrons and their center of mass motion in the field of the nucleus. To the first order the integrand of the integral over the transferred impulse q differs from that arising in Born's approximation by an additional factor. The calculated cross sections for the $1s \rightarrow 2p$ and $1s \rightarrow 2s$ transitions are in good agreement with experiment. (auth)

32406 IONIZATION OF HYDROGEN BY ELECTRONS ALLOWING FOR DISTORTION OF INCIDENT AND OUTGOING WAVES. V. Veldre, I. Vinkalns, and E. Karule (Inst. of Physics, Riga). p.253-5 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Ionization of hydrogen by electron impact is calculated in both Born, Born-Oppenheimer, and Born-Exchange approximations, allowing for distortion of both incident and scattered waves. Incident partial waves $0 \leq L_0 \leq 6$ are included. (auth)

32407 IONIZATION OF HYDROGEN ATOMS USING CLOSE COUPLING WAVE FUNCTIONS. P. G. Burke and A. J. Taylor (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.256-62 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The ionization of hydrogen atoms by electron impact from the ground state and from the excited 2S state is being calculated. The initial anti-symmetrical wave function assumed was obtained from a numerical solution of coupled integro-differential equations. These are derived assuming that only transitions between the 1S, 2S, and 2P states are important. The ionization amplitude was derived by standard methods and the only approximation is the limitation of the initial wave function. The method is also applicable to the ionization of He^+. (auth)

32408 ELECTRON IMPACT IONIZATION OF HIGHLY EXCITED ATOMIC HYDROGEN. K. Omidvar and E. Sulli-

van (Goddard Space Slight Center, Greenbelt, Md.). p.263-73 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A general formula is derived for ionization of the hydrogen atom from any energy level by electron impact. This has become possible by using parabolic coordinates to describe the initial and the final states of the atom in the ionization matrix instead of the usual spherical polar coordinates for the initial, and parabolic coordinates for the final atomic states. The approximation used in the Born approximation in which the bombarding electron before and after collision is described by a plane wave, and the ejected electron by a Coulomb wave function. The program in progress would determine the total ionization cross sections for the first five energy levels of the hydrogen atom. (auth)

32409 CLOSE COUPLING APPROXIMATION CROSS SECTIONS FOR THE SCATTERING OF ELECTRONS BY HYDROGEN ATOMS (n = 3,4,5,6). S. Ormonde (Lockheed Missiles and Space Co., Palo Alto, Calif.) and K. Smith. p.274-6 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The close coupling calculations of Burke, Schey, and Smith were extended by inclusion of the higher lying hydrogen eigenstates up to n = 10. Partial wave contributions to cross sections for transitions to and among the n = 2, 3, 4, 5, 6 states are being calculated for incident electron energies in the range 0.1 – 50 ev. Available results are presented. (auth)

32410 IONIZATIONS OF LITHIUM BY ELECTRONS. G. Peach (University Coll., London) and M. R. C. McDowell. p.277-81 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The cross section for ionization of lithium by electron impact is calculated using Born's approximation. Hartree-Fock wave functions are used for the bound states, the contributions from the partial waves of the ejected electron function for which l = 1 and 2 being calculated both with Coulomb functions ($z_{eff} = 1$) and with Hartree-Fock continuum functions. Several simple approximations for computing ionization cross sections are discussed. The results are compared with experiment. (auth)

32411 NONADIABATIC THEORY OF INELASTIC SCATTERING. H. L. Kyle and A. Temkin (Goddard Space Flight Center, Greenbelt, Md.). p.282-92 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The relative s-wave part of the S-wave scattering of electrons from hydrogen is solved above the threshold for inelastic scattering. This problem is equivalent to a close-coupling expansion incorporating all s-states of the atom including the continuum. The salient differences of the results from the 1s-2s close-coupling results for the 1s-2s excitation cross section are about a 40% reduction over most of the energy range for singlet scattering. In addition the results indicate a sharp resonance right above threshold which is only weakly simulated in the 1s-2s expansion. This resonance shows that the Wigner threshold variation law is only valid to within hundreths of an electron volt above threshold. The reduction over the remaining parts of the energy range indicates that the inclusion of more states in the complete close-coupling calculation will reduce the theoretical results to within the experimental measurements. (auth)

32412 UNSTABLE PARTICLES AND THREE-BODY SYSTEMS. C. Lovelace (Imperial Coll. of Science and Tech., London) and I. C. Percival. p.295-303 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The properties of wave functions of unstable particles and the analytic structure of three-body scattering operators are considered. (auth)

32413 MANY-CHANNEL QUANTUM DEFECT THEORY. O. Bely (Observatoire de Paris, Meudon, France), D. Moores, and M. J. Seaton. p.304-11 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Quantum defect theory, developed for one-channel problems, is extended to the many-channel case. It is shown that the asymptotic forms of the wave functions for neutral atoms and positive ions may be expressed in terms of a certain matrix η which is a slowly varying function of the energy. As an illustration of the use of the method, it is shown that η may be determined using energy-level data for perturbed series. On extrapolating η, cross sections may be deduced for elastic and inelastic collisions. The cross sections show resonances of auto-ionization type. (auth)

32414 CALCULATION OF THE s-WAVE PHASE SHIFT FOR POSITRON HYDROGEN SCATTERING BY A MINIMUM PRINCIPLE. Yukap Hahn, Thomas F. O'Malley, and Larry Spruch (New York Univ., New York). p.312-17 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

As the first extensive application of the improved minimum principle developed recently for single-channel scattering, the s-wave scattering of low energy positrons by atomic hydrogen was considered. The static equation is solved exactly (numerically), and the corresponding Green's function is constructed. The trial function is orthogonalized to the ground state of hydrogen. The trial function contains, for each value m of the angular momentum of the atom, arbitrary linear combinations of exponential-polynomial functions in separable form with linear and non-linear variational parameters. To simplify the orthogonalization, r_1, r_2, θ coordinates are employed, rather than the set r_1, r_2, r_{12}. Contributions from each m, their mutual coupling, and convergence in m are studied. Numerical results are presented and compared with previous calculations using different methods. (auth)

32415 ELECTRON IMPACT 2s AND 2p EXCITATIONS OF ATOMIC HYDROGEN. Kazem Omidvar (Goddard Space Flight Center, Greenbelt, Md.). p.318-23 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A numerical calculation was carried out to evaluate the 3×3 cross section matrix involved in the electron impact excitation of the ground state of H atom to the 2s and the 2p levels. The method of solution is that of the atomic eigenstates expansion. The definite integral terms in the coupled radial differential equations are eliminated through some linear transformation of the radial functions, thus avoiding iteration of these equations. As a result, the equation of reciprocity and the equation of continuity of currents are on the average satisfied numerically with an error to value ratio less than 1 per 1000. A simple perturbation theory was developed to evaluate the effect of the long range and the centrifugal potentials. The six cross sections, 1s–2s, 1s–2p, 2s–2p, 1s–1s, 2s–2s, and 2p–2p are tabulated. The 1s–2s cross section above threshold is investigated. (auth)

32416 THE SCATTERING OF ELECTRONS BY HYDROGEN CALCULATED BY THE SECOND BORN AND CLOSE COUPLING APPROXIMATIONS WITH THE INCLUSION OF COUPLING TO THE n = 3 STATES. A. J. Taylor and P. G. Burke (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.324-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The 1S–2S excitation cross section of hydrogen atoms by electron collision was calculated by the second Born approximation including exchange and by solving closely coupled integro-differential equations. The second Born approximation method took into account coupling between 1S, 2S, 2P, and 3S states. The results agree fairly well with experimental values above 30.5 ev. It was found that the inclusion of the 3S state reduced the 1S–2S cross section considerably, and brought the result into much better agreement with experiment. The close coupling approach included the 1S, 2S, 2P, 3S, and 3P states. The cross section for the 1S–2S transitions at 16.5 ev was more than 30% below the value obtained by the same method including just the 1S, 2S, and 2P states. The results for the other transitions were less markedly influenced by the inclusion of the 3S and 3P states. It is concluded on the basis of the above results that many more states must be included to obtain convergence for the 1S–2S cross section. This is at present impracticable with the use of the eigenfunction expansion method. (auth)

32417 THE 2s–3s EXCITATION OF HYDROGEN ATOMS BY ELECTRON IMPACT. F. R. Pomilla (St. John's Univ., New York) and J. Shapiro. p. 330-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Cross sections for this excitation are calculated in the second Born approximation by including only terms to the third order in the interaction energy. Allowance is made for the spherical distortion and polarization of the target due to the fifteen intermediate hydrogenic states from 1s through 4s. These states were found to make a significant contribution to the cross sections only for small angle scattering, where the intermediate 3p state is the major contributor. At an incident energy of 220 ev, there is still a 3% difference between the first Born and the third order approximations to the cross section. However, a comparison of the results with those of a similar calculation made on the 1s–2s excitation of atomic hydrogen suggests that the first Born is a better approximation at the lower incident energies for electron scattering from excited states than for electron scattering from the ground state. (auth)

32418 THE SCATTERING OF ELECTRONS BY He^+. P. G. Burke (Atomic Energy Research Establishment, Harwell, Berks, Eng.), D. D. McVicar, and K. Smith. p.339-47 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The cross sections for the excitation, by electron impact, of He^+ from the ground state to the 2S and 2P states were calculated. A close coupling approximation is used to obtain results from 40.8 to 217.6 ev incident electron energy. The 1S, 2S, and 2P states are retained in an antisymmetrized expansion of the total wave function. This approximation is expected to be better here than for scattering by hydrogen, where its convergence was shown to be very slow. However its validity is also being checked by including the 3S and 3P states in test runs. Preliminary results indicate that of the approximations for Q(1S–2S) used by Burgess the Coulomb-Born II is the most accurate at the lower energies. In particular, at 81.6 ev a value of $\approx 0.0132\ \pi a_0^2$ is obtained for this transition. (auth)

32419 HYDROGENIC CONTINUUM ELECTROSTATIC INTEGRALS. E. J. Callan, P. Nikolai, and W. L. McDavid (Aerospace Research Labs., Wright-Patterson AFB, Ohio). "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A matrix method for computation of hypergeometric functions involved in calculating bound-free matrix elements is presented, which eliminates series summation truncation errors. Tabulations of various two electron electrostatic interaction integrals to continuum states are given for hydrogenic wave functions, for a variety of energies of the continuum electrons ranging from k ≡ 0.05 to 30 Å. (auth)

32420 APPLICATION OF THE ITERATION VARIATION METHOD TO COUPLED EQUATIONS. H. E. Saraph (University Coll., London). p.359-63 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

In the simplest example of two coupled equations it is shown that the iteration-variation method can be successfully applied to solve such problems. Convergence is as fast as in the case of single equations. The reactance matrix for 2s–2p coupling in hydrogen with exchange is obtained for the special case of total angular momentum L = 0. (auth)

32421 AN EQUATION FOR SYSTEMS OF IDENTICAL PARTICLES. E. Corinaldesi (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). p.364-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Perturbation calculations involving identical particles with non-orthogonal unperturbed eigenfunctions can be performed by conventional iterative methods based on a modified Schroedinger equation. This equation, which embodies the ordinary Schroedinger equation and the symmetry conditions for the wavefunction, takes the latter into account as interactions among functions differing from one another by permutations of the particles coordinates. Applications of the method to scattering of electrons by atoms and to the calculation of energies of diatomic molecules are presented. (auth)

32422 THEORETICAL DISCUSSION SESSION. p.370-81 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The theoretical papers on electron-atom collisions presented in section V of the conference proceedings are discussed. (C.E.S.)

32423 PARALLEL INFORMATION SESSION ON EXPERIMENTAL PROBLEMS. p.382-92 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Experimental problems involved in carrying out measurements on ion-atom, electron-ion, electron-atom, and atom-atom collision processes are discussed. (C.E.S.)

32424 INELASTIC ELECTRON-MOLECULE COLLISIONS. Charles A. McDowell (Univ. of British Columbia, Vancouver). p.395-414 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Low energy inelastic electron-molecule collisions are reviewed, particular attention being paid to experimental methods of determining appearance potentials. Recent work on negative ion electron affinities is discussed. (auth)

32425 THE DISSOCIATION OF HYDROGEN MOLECULES BY RESONANT ELECTRON SCATTERING. J. N. Bardsley, A. Herzenberg, and F. Mandl (Univ. of Manchester, Eng.). p.415-27 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The resonance peaks in the cross section for the process $H_2 + e \rightarrow H + H^-$ are treated by assuming that in any one peak the wave function is dominated by a single electron resonance when the electron is near the protons. The resulting proton wave equation contains a complex electronic energy whose real part is repulsive and pushes the protons apart, while the imaginary part, coming from the instability of the resonance against decay by electron emission, leads to a damping of the proton wave. It contains also an inhomogeneous source term, coming from the incident wave. The wave equation is solved in WKB approximation. (auth)

32426 SECONDARY EFFECTS IN ELECTRON EXCITATION OF SOME NITROGEN BANDS. W. F. Sheridan (Air Force Cambridge Research Labs., Bedford, Mass.), O. Oldenberg, and N. P. Carleton. p.440-2 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

In a systematic investigation of the cross sections for electrons (120 to 20,000 ev) of some nitrogen bands, anomalous pressure effects were found. The intensity of the first negative bands of N_2^+ is proportional to the pressure as expected. That of the first positive bands of N_2 increases at a higher rate, presumably due to the effect of secondary electrons. The intensity of the Meinel bands of N_2^+, however, increases at a rate less than proportional to the pressure. The only possible explanation seems collisional deactivation. In order to estimate the half-life a direct photograph of the beam in the light of a Meinel band was taken. It shows the beam broadened indicating that the excited molecules diffuse out during a half-life of about 3×10^{-6} sec. Combined with the curves intensity versus pressure this attributes to the collisional deactivation a cross section of 2×10^{-14} cm^2. (auth)

32427 EXPERIMENTAL THRESHOLD LAWS FOR IONIZATION IN THE RARE GASES. Dwight A. Hutchison (Argonne National Lab., Ill.). p.443-50 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Experimental threshold laws for ionizing by electron impact in the rare gases were determined. The energy-selected electron beams employed in these experiments were obtained by use of a parallel-plate electrostatic energy selector. A second parallel-plate analyzer furnished information on the electron-energy distributions used in producing ionization. Distributions were measured for beams selected at 25.0 to 7.5 volts energies. Beams selected at 3.5 volts were used in studies of ionization in the rare gases. Electronic differentiation of ion-appearance-potential curves was obtained by superposing a sine-wave voltage signal on the electron beam and measuring the amplitude signal generated in the ion beam. Computer calculations of the integral of the product of the electron-energy-distribution functions and assumed threshold functions yield ionization intensity functions and their first derivatives with energy in close agreement with experimentally measured ones. (auth)

32428 AUTO-IONIZATION AND THE IONIZATION EFFICIENCY CURVES FOR KRYPTON AND XENON. J. F. Burns (Oak Ridge National Lab., Tenn.). p.451-60 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Ionization efficiency curves for xenon are presented which exhibit structure at electron energies corresponding to atomic levels that are known to be strongly auto-ionizing from optical absorption spectra. A brief description of the apparatus and experimental procedures is given. It is pointed out that if the observed structure is indeed the result of auto-ionization then the ionization efficiency curves of the rare gases are of little use in making a choice between the various threshold laws for ionization under electron impact. (auth)

32429 ELECTRON-IMPACT IONIZATION OF ATOMS AND MOLECULES USING A FAST CROSSED-BEAM METHOD. J. R. Peterson (Stanford Research Inst., Menlo Park, Calif.). p.465-73 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Cross sections for the ionization of N, N_2, Ar, and Ne by electron impact were measured using energetic (2–3 kev) beams of neutral particles in a crossed-beam arrangement. The neutral beams were obtained from mass-analyzed ion beams by charge transfer; their intensities were measured thermally and absolute cross sections were obtained. Some sources of interference which may have influenced earlier data were eliminated by apparatus modifications. Recent results on the dissociative ionization of N_2 have contradicted previous results which indicated a very low yield for electron energies below 50 ev. The sums of single and double ionization cross sections for N_2 and Ar are somewhat higher than the total ionization measured in static gases by Tate and Smith, and the ratios of double to single ionization currents in Ne and Ar are different from that found by Bleakney. However, all cross sections have normal threshold energies. The atomic nitrogen cross section has an energy dependence similar to that found by A. C. H. Smith et al., but is about twice as large. (auth)

32430 ELECTRON-ION RECOMBINATION. D. R. Bates (Queen's Univ., Belfast). p.487-90 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A brief survey is given of theoretical work on collisional-radiative recombination. (auth)

32431 AFTERGLOW ATOMIC COLLISION PROCESSES. Manfred A. Biondi (Univ. of Pittsburgh). p.491-509 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A brief review is given of the atomic collision processes occurring at low energies (<0.1 ev) which were studied by afterglow techniques. The techniques used to study the initially ionized gas include: microwave conductivity and noise measurements to determine the average electrons density, collisions frequency, and temperature, optical absorption to measure metastable atoms and molecule concentrations, optical spectrographic and interferometric measurements of excited atom concentrations and temperatures, and mass spectrographic observations of the ions present in the afterglow. With these techniques cross sections at thermal energies were determined for elastic scattering of electrons, positive ions, and metastable atoms by neutral atoms. Ionizing collisions between slow metastable atoms were observed by microwave and optical absorption techniques. The capture of thermal electrons by oxygen molecules (Bloch-Bradbury attachment) was studied in afterglows using microwave techniques. The large two-body recombination of electrons and positive ions was investigated by microwave, optical and mass spectrometric techniques and was shown to be the result of dissociative recombination. Recombination cross sections for particular ions (e.g., N_2^+) were determined at thermal energies. (auth)

32432 PHASE SPACE CALCULATION OF THREE BODY ELECTRON-ION RECOMBINATION RATES. B. Makin (Univ. of Southampton, Eng.) and J. C. Keck. p.510-16 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A three body electron ion recombination rate was calculated using a classical phase space concept. The collision between three particles is represented by a point in phase space, and a distribution of points is assumed corresponding to a gas in thermodynamic equilibrium. A trial surface separating the free and bound states of the ion-electron pair is chosen at an arbitrary energy below the dissociation limit and the rate at which representative points cross it is calculated. A least upper bound to the recombination rate is obtained by minimizing this crossing rate with respect to the energy level of the trial surface. The minimum occurs when the trial surface is at a depth approximately $\frac{5}{2}$ kT below the continuum. Evaluating the rate at the minimum, numerical values are found that agree favorably with other classical results obtained from summing the collisional de-excitation processes. (auth)

32433 THE MOLECULAR SPECTRUM IN A HELIUM AFTERGLOW. C. B. Collins, W. B. Hurt, and W. W. Robertson (Univ. of Texas, Austin). p.517-24 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A visible afterglow was obtained when purified helium was passed at high velocity through a microwave discharge. The appearance was of a bright pinkish-violet column tailing downstream from the discharge. The length of the afterglow in a particular system varied from a few to fifteen or more centimeters, depending upon the pressure. Both atomic and molecular radiation was observed in the afterglow and the variation in intensity with pressure (5 to 45 mm Hg) and time (60 to 250 microseconds from discharge) indicates the origin of the radiation. (auth)

32434 THE BOUND-FREE ABSORPTION COEFFICIENT OF THE NEGATIVE HYDROGEN ION. N. A. Doughty and P. A. Fraser (Univ. of Western Ontario, London, Can.). p.527-36 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The absorption coefficient of H^- was determined using bound functions of Hylleraas and Schwartz form with Hartree-Fock free waves including the 1s, 2s, and 2p states of hydrogen in an eigenfunction expansion. (auth)

32435 ENERGY DEPENDENCE FOR THE PHOTODETACHMENT OF I^- NEAR THRESHOLD. B. Steiner, M. L. Seman, and L. M. Branscomb (National Bureau of Standards, Washington, D. C.). p.537-42 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The photodetachment of atomic iodine negative ions was observed in a crossed beam experiment with much higher spectral resolution than previously used. The iodine negative ions were formed in a discharge through an ammonia-iodine vapor mixture and mass analyzed in the apparatus used in previous experiments. The photon beam originated in a high pressure xenon lamp and was resolved in an F/1.5 monochromator. The threshold region near 4040 Å was scanned with a photon beam half width of 18 Å, and the region down to 3000 Å with a half width of 33 Å. Transitions ascribed to $^1S_0 \rightarrow {}^2P^0_{\frac{3}{2}}$ and $^1S_0 \rightarrow {}^2P^0_{\frac{1}{2}}$ were observed. The experimental slit function was unfolded from the first threshold region to reveal the true threshold behavior. The derived radiative attachment cross section in region of the threshold is presented. (auth)

32436 RADIATIVE CAPTURE OF ELECTRONS BY HALOGEN ATOMS. R. Stephen Berry and Carl W. David (Yale Univ., New Haven). p.543-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The direct spectroscopic observation of radiative capture of electrons by the free gaseous halogen atoms Cl, Br, and I is reported. The spectra were obtained from emission produced by alkali halides vaporized and dissociated by shock-heating. The sharp onsets of radiation due to capture of electrons of zero energy are clearly visible. The radiation intensity dependence near onset is, within experimental uncertainty, consistent with the photodetachment spectra, the Wigner threshold law and microscopic reversibility; that is, the capture cross section becomes very steep at threshold and the light intensity appears to rise as $(\nu - \nu_0)^{\frac{1}{2}}$ as a function of ν. The continua are identified by shape and threshold wavelength, and in the case of Cl and Br, by the presence and wavelength of continua due to capture of electrons by atoms in their excited $^2P_{\frac{1}{2}}$ states. Threshold wavelengths are: 3427 ± 4 and 3327 ± 4 Å for Cl; 3688 ± 4 and 3249 ± 3 Å for Br, and 4046 ± 4 Å for I. These are in good agreement with the photodetachment thresholds. Capture cross sections for electrons with energy of 0.025–0.035 ev are approximately 10^{-21} cm^2. (auth)

32437 MEASUREMENT OF ELECTRON ATTACHMENT AND IONISATION CROSS SECTIONS IN CARBON DIOXIDE. R. K. Asundi and J. D. Craggs (Univ. of Liverpool). p.549-55 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Cross section measurements for electron attachment and ionization in carbon dioxide were made using an electron beam experiment under single collision conditions. Two resonant attachment peaks are observed. The cross section values corresponding to the two maxima are $1.3 \pm 0.2 \times 10^{-19}$ and $4.5 \pm 0.6 \times 10^{-19}$ cm^2 at 4.3 and 8.3 respectively. The attachment and ionization cross section values obtained were employed to evaluate the ionization and attachment coefficients α and η assuming both Maxwellian and Druyvesteyn forms of distributions and compared with the values obtained in swarm experiments. (auth)

32438 SIMULTANEOUS DETERMINATION OF THE ELECTRON ATTACHMENT AND DETACHMENT RATES IN OXYGEN. L. Fromhold (Universität, Hamburg). p.556-64 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Quantitative data for electron attachment and detachment from negative ions in oxygen were obtained by an investigation of electron avalanches in uniform fields. A pressure range of 1–50 torr, and a ratio of field strength to pressure of 40–150 volt/cm · torr was used. The results indicate the negative atomic ion, O^-, being formed in the ground state. Electron detachment takes place by a two-body collision process, presumably $O^- + O_2 \rightarrow e + O + O_2$. The observed mean lifetime of O^- is very small against the transit time under the conditions used. Preliminary results in air confirm these conclusions. (auth)

32439 AFTERGLOW MEASUREMENTS IN XENON AND XENON–WATER VAPOR MIXTURES. P. J. Chantry (University Coll., London). p.565-73 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Measurements were made of electron density decay rates in xenon and xenon–water vapor mixtures by the microwave cavity method. In the case of pure xenon these show a behavior of the type observed in the lighter rare

gases, the decays at low pressures (<1 mm Hg) being diffusion controlled, modified by diffusion cooling effects. Results at higher pressures (>5 mm Hg) are consistent with recombination control, and when corrected for diffusion and the effect of the high collision probability for thermal energy electrons in this gas, provide an extrapolated value for the recombination coefficient $1.6 \times 10^{-6} > \alpha \gtrsim 1.2 \times 10^{-6}$ cm^3/ion sec. The addition of small proportions of water vapor increases the decay rates by a large factor, the effect being due to fast recombination ($\alpha \approx 10^{-5}$ cm^3/ion sec) with ions produced from the water vapor. With 5 parts of water in 10^5 of xenon the effect was still present. (auth)

32440 THE THREE-BODY PROCESS OF ELECTRON ATTACHMENT IN AIR. J. Dutton, F. M. Harris, and F. Llewellyn-Jones (University Coll., Swansea, Wales). p.574-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Values of the total attachment cross section determined from measurements of pre-breakdown ionization currents at values of E/p (E the electric field, p the gas pressure) in the range 30 to 38 v cm^{-1} mm Hg^{-1} are given and shown to be considerably lower than (about half) previously observed values in this range. It is also shown that the observed dependence of the apparent primary ionization coefficient on gas pressure at E/p ≈ 35 v cm^{-1} mm Hg^{-1} is consistent with the operation of the process of three-body attachment with a cross section of about 10^{-21} cm^2 which is about one tenth of the total attachment cross section. (auth)

32441 RESONANCE ABSORPTION BY NITROGEN ATOMS IN AFTERGLOWS. K. C. Clark and C. E. Fairchild (Univ. of Washington, Seattle). p.581-5 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Photoelectric absorption spectrometry applied to directly calibrated measurements of atomic nitrogen concentrations in flowing nitrogen afterglows shows ground state ^{4}S atoms in typical amounts of 10^{14} to 10^{13} cm^{-3}. The need for high resolution is avoided by use of the resonance line emission of the 3s ^{4}P–(2p)^3 ^{4}S triplet at 1200 Å as the background source, although the lines are individually resolved. Similarly the metastable atoms in the afterglow produce absorption of the 3s ^{2}P–(2p)^3 ^{2}D (1493–5Å) and 3s ^{2}P–(2p)^3 ^{2}P (1743–5Å) doublets which is typically 10^{-3} to 10^2 as great as that of the ground state atoms. The atomic concentrations do not change appreciably in the formation of the delayed, intense pink afterglow in very fast flowing pure nitrogen. The absorption cross sections are interpreted in terms of the oscillator strengths under the assumption of properly chosen Doppler profiles for emission, self reversal, and absorption. (auth)

32442 THE CALCULATION OF THE PHOTOIONIZATION CROSS SECTION OF LITHIUM. J. H. Tait (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.586-94 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The photoionization cross section of lithium is calculated by the dipole length and dipole velocity formulas, using a wave function for the lithium atom containing correlation terms that allow for inter shell polarization. The latest experimental curve lies between the two theoretical curves; the dipole velocity formula gives results in agreement with previous calculations, while the dipole length formula gives values greater but in closer agreement with the measured values. These results indicate that there is no disagreement between theory and experiment. (auth)

32443 THE CALCULATION OF AUTOIONIZATION PROBABILITIES. J. W. Cooper (National Bureau of Standards, Washington, D. C.). p.595-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Calculations were carried out for the autoionization probabilities and level widths of the doubly excited states (2snp)^{1,3}P and (ns2p)^{1,3}P,n = 2, 3, 4 in He. Although the model used for the calculations was crude, the level widths computed agree order of magnitude-wise with recent experimental observations. The probable effect of the strong coupling between levels of the above series for n > 2 and of additional configuration mixing is discussed. The calculations point up the fact that the important region for the auto-ionization process corresponds to small radial distances from the nucleus. It was also found that the results were relatively insensitive to the exact form of the wave functions and for the calculations. (auth)

32444 METASTABLE LEVELS IN THE CONTINUUM AND THE INDEPENDENT PARTICLE MODEL. F. Prats and U. Fano (National Bureau of Standards, Washington, D. C.). p.600-5 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Resonances in scattering processes and the related metastable levels of atoms, molecules, or ions, which decay by autoionization, predissociation or Auger effect, are generally classified by quantum numbers of an independent particle model. This model often affords only a quantitatively very poor initial approximation, and one may wonder how to define operationally meaningful concepts, such as decay rates and line shapes, so that they be independent of the initial approximation. This definition can be achieved in terms of a reaction matrix or, equivalently, in terms of the matrix of the residual interaction in an intermediate representation which is obtained from the independent-particle states by a process of partial, or preliminary, diagonalization. (auth)

32445 INELASTIC HEAVY PARTICLE COLLISION PROCESSES. A. Dalgarno (Geophysics Corp. of America, Bedford, Mass.). p.609-17 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Recent developments in the theoretical description of inelastic heavy particle collision processes are discussed. (auth)

32446 CROSS SECTIONS FOR LYMAN ALPHA EMISSION RESULTING FROM PROTON AND DEUTERON-RARE GAS COLLISIONS. D. Pretzer, B. van Zyl, and R. Geballe (Univ. of Washington, Seattle). p.618-23 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Non-resonant charge transfer cross sections for Lyman alpha emission produced by 1–25 kev protons and 0.5–25 kev deuterons colliding with rare gas atoms are presented. A variable energy d-c ion beam is focused into a low pressure target gas cell and the resulting photons counted with an oxygen-filtered, helium-iodine photon counter. The resulting cross sections for both deuterons and protons exhibit structure that becomes more pronounced with increasing mass of the target atom. Plotted on a velocity scale the deuteron and proton cross sections exhibit similar structure. (auth)

32447 EXCITATION OF Ne INDUCED BY H^+ AND He^+ IMPACT. (5-35 kev). F. J. De Heer and J. Van Eck (FOM-Lab. for Mass Separation, Amsterdam). p.635-43 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Absolute excitation cross sections were determined for impact radiation in case of H^+ and He^+ incident on neon, both in the far ultraviolet wavelength region (200–1250 Å) and between 2000–6400 Å. A remarkable result was obtained for the NeI 3s–2p lines at 736 and 744 Å, which were induced by He^+ impact. The light intensity increases rapidly with decreasing impact energy and a maximum is present below 5 kev. A similar behavior was found for 3p–3s lines measured in the visible spectral region. The polarization fraction of these lines is negative and close to zero at 5 kev, which may be partly due to cascade effects. The mentioned rise in the light intensity has not been found in 3d–3p lines and in lines induced by proton impact. The induced Ne spectrum shows many Ne II lines, which are partly induced by an electron-capture process and which are at least as intensive as Ne I lines. (auth)

32448 EXCITATION BY POSITIVE IONS IN THE ENERGY RANGE 60-500 kev. E. W. Thomas and H. B. Gilbody (University Coll., London). p.644-51 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Observations were made of some of the more prominent spectral lines arising as a result of various excitation mechanisms when a beam of various singly charged positive ions traverses a gas in single collision conditions. Measurements were made in the spectral range 4000–8000 Å using a large aperture two prism spectrograph. Photoelectric detection was used, the effects of noise arising from the multiplier and associated electronics being minimized by chopping the light entering the spectrograph at 180 c so that the resulting signal could be identified by its having a specific frequency and phase. The overall quantum efficiency of the spectrograph was determined by calibration against a standard tungsten light source. A parallel plate condenser system allowed simultaneous measurements of slow ion and electron currents to be made and permitted continuous monitoring of the main beam intensity. The results can be discussed with reference to related charge rearrangement collisions. (auth)

32449 EXCITATION AND CHANGE OF CHARGE IN ION MOLECULE COLLISIONS IN THE ADIABATIC REGION. S. H. Neff and N. P. Carleton (Harvard Univ., Cambridge, Mass.). p.652-60 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Absolute cross sections were measured for excitation in ion-neutral and neutral-neutral collisions in the energy range of 400–2000 ev, using Ne^+, Ar^+, N_2^+, Ca^+, Mg^+, Na^+, K^+ ions and N_2 chiefly as the target gas. Most cross sections measured to date are for interactions accompanied by charge exchange, though some exist for collisions in which the colliding particles do not change identity. The variations of these cross sections with energy often show strong departures from the predictions based on an adiabatic approximation, showing that it is not realistic to consider only the separation of initial and final states in describing the collision. The absolute magnitude of the cross sections varies from 10^{-20} to more than 10^{-17} cm^2. All cross sections increase with increasing energy in the energy range. Charge capture cross sections for the metallic ions in N_2 are in the range of a few times πa_0^2 and increase slowly with increasing energy. Work is now in progress on ionization in neutral-neutral collisions and further study of excitation in such collisions, which was largely obscured in earlier work by the presence of ions in the beam. (auth)

32450 IONIZATION CROSS SECTIONS FOR NEUTRAL HELIUM ATOMS ON HELIUM, NEON AND NITROGEN. N. G. Utterback (Univ. of Denver). p.661-5 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The ionization cross sections for He atoms on impact with He and Ne atoms and N_2 molecules were measured over the laboratory energy range from 40 to 1000 ev. The incident atomic beam was produced by the technique of ionization by electron impact, electrostatic acceleration, and neutralization by charge transfer. The measurements were carried out in a low-pressure parallel plate ionization chamber. Particular attention was paid to the problem of secondary electrons. The ionization cross sections obtained for the He–He and He–Ne interactions were smaller than 5×10^{-17} cm^2 over the energy range studied, and were thus one-to-two orders of magnitude smaller than the N_2–N_2, N_2–O_2, and O_2–O_2 cross sections studied earlier. The He–N_2 cross section, on the other hand, was found to be of the same order of magnitude as the N_2–N_2 cross section. (auth)

32451 EXPERIMENTAL STUDY OF PROTON-ATOM HYDROGEN COLLISIONS IN THE ENERGY RANGE 60-450 kev. J. V. Ireland and H. B. Gilbody (University Coll., London). p.666-71 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The ionization of atomic hydrogen by protons was investigated using the crossed beam technique. An atomic hydrogen beam, produced in a high temperature furnace is modulated at 180 c by a mechanical chopper, and intersects a proton beam from a Van de Graaff accelerator. The fraction of atomic hydrogen in the beam is determined by ionizing it with a crossed electron beam and comparing the resulting H^+ and H_2^+ ion currents by means of a mass spectrometer. The signal arising from the ionization of a beam of essentially atomic hydrogen is compared with that from a molecular hydrogen beam of the same intensity making allowance for the furnace temperature. A knowledge of the absolute cross section for the ionization of molecular hydrogen allows the corresponding atomic cross section to be determined. (auth)

32452 POSITIVE ION STRIPPING AND NEUTRALIZATION STUDIES IN THE ENERGY RANGE 100-450 kev. A. R. Lee and H. B. Gilbody (University Coll., London). p.672-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Cross sections for the loss of one and two electrons by the singly charged ions He^+, Ne^+, and Ar^+ were measured in the gases hydrogen, helium, neon, argon, and krypton. The measurements were made by analysis of the primary beam in single collision conditions. The geometry of the target gas cell restricted measurements to cases where the loss of electrons is accompanied by scattering of the primary ions through angles $\leq 2°$. In the cases considered scattering outside this angular range was small. The data can be discussed with reference to related charge rearrangement collision processes. Preliminary measurements of the neutralization of the primary beam were made using a modified Schwartz thermopile as a sensitive fast neutral atom detector. (auth)

32453 MEASUREMENT OF dE/dR IN GASES WITH LOW ENERGY HEAVY PARTICLES. G. Sidenius (Universitet, Copenhagen). p.709-16 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The stopping power dE/dR of H_2 gas for particles with mass numbers from 23 to 238 was measured at energies

from 10 to 50 kev. The particles used were ^{23}Na, ^{35}Cl, ^{40}Ca, ^{56}Fe, ^{69}Ga, ^{74}Ge, ^{90}Zr, ^{121}Sb, ^{208}Pb, and ^{238}U. Curves illustrating the pure nuclear stopping power and the pure electronic stopping power were presented. (C.E.S.)

32454 MEASUREMENTS OF ATOMIC AND IONIC PARTIAL STOPPING POWERS FOR H AND He BEAMS IN GASEOUS HYDROGEN. S. K. Allison (Univ. of Chicago). p.717-25 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The partial atomic stopping power ϵ_0 of a gas for an atomic projectile that has experienced no charge changing collisions is measured by placing the absorption cell in a strong transverse magnetic field. Likewise ϵ_1 for a singly charged ionic projectile can be measured by noting the energy degradation, with increasing gas pressure, of an ionic beam closely confined to a curved orbit in a magnetic field. The ordinary, or total stopping power is $\epsilon = \Sigma_i F_{i\infty}\ \epsilon_i + \Sigma_{i,f} F_{i\infty} W_{if} \sigma_{if}$. Thus from partial and total stopping power measurements, from the known equilibrium fractions $F_{i\infty}$ and charge changing cross sections σ_{if}, the contribution of the charge changing processes to ϵ can be determined. Results are given for the hydrogen beam—hydrogen gas target system from 20 to 150 kev, and for the helium beam—hydrogen gas system in the two component region from 35–175 kev. The stopping power ϵ_2 for He^{2+} in hydrogen gas is under investigation. For 50-kev H, and 170-kev He beams $\sigma_{10} = \sigma_{01}$ in H_2 gas. At this condition 34% of dE/dx for the H beam, and 37% for the He beam, is lost in charge changing collisions. (auth)

32455 FORMATION OF HYDROGEN ATOMS IN EXCITED STATES BY ELECTRON CAPTURE. A. C. Riviere and D. R. Sweetman (United Kingdom Atomic Energy Authority, Culham, Berks, Eng.). p.734-42 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The ionization of excited hydrogen atoms by a strong electric field was used as a technique to measure the degree of excitation of a beam of hydrogen atoms. The ratio of the cross section for electron capture into the n = 14 excited state to that for capture into all states in hydrogen gas was found to be 2.6×10^{-4} at 25 kev rising to 7.1×10^{-4} at 100 kev. For thick hydrogen gas targets the equilibrium value of the excited state population was found to be 1.1×10^{-4} at 25 kev rising to 4.8×10^{-8} at 100 kev. From the thick target results the cross section for electron loss from the n = 14 excited state could be estimated to within a factor of two, and this was found to be 5.3×10^{-16} cm^2 at 25 kev decreasing to 7.2×10^{-17} cm^3 at 100 kev. (auth)

32456 THE DISSOCIATION CROSS SECTION OF H_2^+ IN HYDROGEN GAS. C. F. Barnett and J. A. Ray (Oak Ridge National Lab., Tenn.). p.743-50 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The dissociation cross section for proton production from H_2^+ ions passing through hydrogen gas was experimentally re-examined in the energy range 40–200 kev. The results, lying in the range around 1.0×10^{-16} cm^2 per target atom, are in essential agreement with recent observations by others, but remain lower by a factor of about 1.6 from the results of Fedorenko and his colleagues. To see whether the cross section might be sensitive to the mode of formation of the H_2^+ (possibly through the population of vibrational levels) the cross section was measured for H_2^+ derived from a radiofrequency ion source; and a Philips ion gauge source. Essentially no difference was found despite variation of the operating parameters of the sources. However, when the H_2^+ ions were derived from dissociation of H_3^+, an increase was noted in the cross section for proton production when the H_2^+ ions were sent through hydrogen gas; the increase varied from 16 percent at 60 kev to 40 percent at 200 kev. (auth)

32457 DISSOCIATION OF H_2^+ IONS. J. Guidini (CEN, Saclay, France). p.751-6 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Cross sections for dissociation, ionization, and charge exchange of molecular hydrogen ions H_2^+ in different gases were measured as a function of energy, between 25 and 250 kev. The charge exchange cross sections show a strong variation with energy, but those for dissociation and ionization are less pronounced. At a given energy the magnitudes show a dependence upon the target atom mass. Comparisons are made with existing data. (auth)

32458 RESONANT CHARGE TRANSFER BY FAST PROTONS IN ATOMIC HYDROGEN. I. M. Cheshire (Univ. of Glasgow). p.757-65 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A new approximation, applicable to ion-atom collisions, is presented and applied to the resonant capture process $H^+ + H(1s) \rightarrow H(1s) + H^+$ in the energy range 1 kev–1 Mev. First and second order cross sections are shown to have the asymptotic energy dependence of the impulse and second Born approximations, respectively. (auth)

32459 HIGH ENERGY CHARGE EXCHANGE. M. H. Mittleman (University Coll., London and Univ. of California, Livermore). p.766-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Historically this problem seems to have been plagued by three difficulties, the post-prior discrepancy, the lack of orthogonality between initial and final states, and the uncertainty concerning the convergence of high energy expansions of the transition matrix. The first problem has two aspects, the practical one of ignorance of bound state wave functions, and the more theoretical one of the lack of equality of higher approximations. The contention is that the latter problem is now understood while the first one is minimized by the correct treatment of the orthogonality problem. The orthogonality problem is now understood. There exist many formulations that ensure an orthogonality between initial and final states. The corrections to the usual results thereby introduced appears to be important. An example of two particle transfer will be presented to illustrate this. The remaining problem in this category is to understand the differences in the various formulations. The high energy problem seems to have no answer at present. There exists a strong argument to suggest that the Born series for the transition matrix does not converge at any energy. Indeed the p + H problem seems to be an example of this. Many groups are investigating models relevant to this problem but no results exist yet. (auth)

32460 DOUBLE ELECTRON CAPTURE OF ALPHA PARTICLES PASSING THROUGH HELIUM. D. Basu, S. C. Mukherjee, and N. C. Sil (Indian Assn. for the Cultivation of Science, Calcutta). p.769-78 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The cross section of the double electron capture for alpha particle passing through helium atoms was calculated for the low energy region by a variational method. The nucleus-nucleus interaction term was not included, and the translatory motion of the electron is neglected for simplification. The numerical results of the calculations are in good agreement with the theoretical results of Ferguson and Moisei-

witsch, who calculated the same problem by the perturbed stationary states method. An expression for the single electron capture was derived. At a fixed scattering angle, the probability of double electron capture is a rapidly oscillating function of the energy (1 to 50 kev region) of the incident ion. (auth)

32461 ON THE IMPACT PARAMETER TREATMENT OF EXCITATION IONIZATION AND CHARGE TRANSFER PROCESSES. J. W. R. Fennema (FOM-Lab. for Mass Separation, Amsterdam). p.779-89 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The impact parameter treatment of an atomic scattering process is governed by a time dependent Schroedinger equation. The use of wave packets enables one to derive this equation and its solutions from the expressions which are the starting point in a wave treatment. The momentum wave functions, as introduced by Bates and McCarrol, can be constructed. They appear to describe a correction, which must be made because the internuclear coordinate does not connect centers of mass in asymptotic situations. Besides, a novel term is found, which results from the finite energy width of the wave packet. This term contains a delay-time, and it expresses complementarity. (auth)

32462 A MODEL FOR CHARGE TRANSFER IN NEAR ADIABATIC COLLISIONS. W. D. Ellison and S. Borowitz (New York Univ., New York). p.790-801 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A model for charge transfer during near adiabatic collisions of atomic systems that exhibit pseudo-crossing of the potential energy terms is taken as $h_{nm} = V_0 \exp[-\beta(R - R_c)]$ and $h_{mm} - h_{nn} = \Delta E[1 - \exp\{-\beta(R - R_c)\}]$ where h_{ij} are the matrix elements of the interaction, R is the relative coordinate of the atomic nuclei, R_c is the crossing distance, ΔE is the energy separation of the potential curves of infinity, and the other constants are simply related to those in the Landau-Zener model. The coupled differential equations for the transition amplitudes are solved exactly for zero impact parameter in terms of confluent hypergeometric functions and are expanded asymptotically in v, the relative speed of the atoms. For $R < R_c$ and v const, the transition probability oscillates about the Landau-Zener value as R decreases. The coupled equations are also integrated numerically for other models and total cross sections calculated. (auth)

32463 INELASTIC COLLISIONS INVOLVING CURVE-CROSSING. J. B. Hasted, A. R. Lee, and M. Hussain (University Coll., London). p.802-6 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Measurements are reported of single-electron capture by doubly charged rare gas ions (excluding helium) in their own gas. The slow singly charged ions formed are extracted from the collision chamber by weak uniform electric fields, mass analyzed, and detected using a particle multiplier. From the impact energies of the cross section function maxima are calculated the energy separation ΔU of the reactant and product potential energy curves at pseudo-crossover, using Bates and Moiseiwitsch's formulation of the Landau-Zener theory. Values of ΔU for these and previous data are compared with those calculated from an approximate formula deduced from the variational theorem; the wave functions are simple spherically symmetrical one-electron expressions with integral values of the effective quantum number n*. While the nuclear separation R_x at pseudo-crossover remains the greatest single factor determining the magnitude of ΔU, other factors are seen to be relevant. Calculated values can be smaller than the experimental for $R_x \lesssim 3$ Å, when large cancellations are seen to occur in the formulas, and when actual n* values are markedly non-integral. Certain departures of the experimental cross section functions from single nuclear separation transition theory are reported. (auth)

32464 CHARGE TRANSFER BETWEEN CESIUM ATOMS AND RUBIDIUM 85 AND RUBIDIUM 87 IONS. L. L. Marino (General Dynamics/Astronautics, San Diego, Calif.). p.807-13 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The cross sections for charge transfer between cesium atoms and mass selected rubidium-85 and rubidium-87 ions were determined as a function of primary ion energy from 100 to 5000 ev. At each energy, the cross section was obtained from measurements of the number of slow ions formed along a known length of the primary ion beam as it passed through cesium vapor, the primary ion beam current, and the number density of cesium atoms inside the interaction region. The anomalous behavior of the measured cross sections is discussed. (auth)

32465 A CHARGE TRANSFER COLLISION INVOLVING ACCIDENTAL RESONANCE. P. H. Edmonds and J. B. Hasted (University Coll., London). p.823-30 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Measurements are reported of the accidentally resonant single charge transfer collision I^+Hg ($\Delta E_\infty = +0.024$ ev), at impact energies E_p down to five electron volts. Narrow ($\sim 0.02\ E_p$) energy distribution of the incident ions is ensured by momentum analysis without subsequent retardation. Separation of the considerable elastic scattering component is achieved by a new single electrode collection technique utilizing parallel electric and magnetic fields. (auth)

32466 CHARGE EXCHANGE WITH SMALL ENERGY TRANSFER. Yu. N. Demkov (Leningrad State Univ.). p.831-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A general formula is derived for electronic charge exchange when the change of the energy of the electron is small relative to the distances between nearest energy levels in both atomic systems. The deduction of the formula is analogous to that of the semiclassical Bohr quantum conditions. For a special case a similar result was obtained earlier by Zener and Rosen. The Massey criterion which defines the position of the maximum of the cross section is examined more precisely. The oscillating character of the differential cross section, analogous to that of the resonance charge exchange, is established. The results obtained can also be applied to a number of other processes, such as an excitation transfer in collisions between atoms or ions. (auth)

32467 MUONIUM AND POSITRONIUM PHYSICS. J. M. Bailey and V. W. Hughes (Yale Univ., New Haven). p.839-46 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Experiments on muonium and positronium give the most unambiguous and precise values of the fundamental constant α, and also give valuable information about many atomic collision processes. (auth)

32468 EFFECTS OF ION BEAM EXCITATION ON CHARGE TRANSFER CROSS SECTION MEASUREMENTS. R. C. Amme and N. G. Utterback (Univ. of Denver). p.847-

53 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The charge transfer cross sections for N_2^+ and O_2^+ ions in N_2 were measured both as a function of ion energy and ion source electron energy. Ion energies were varied between 40 and 1000 ev, and the ion source electron energy was varied between 16 and 24 ev. The resonant N_2^+ in N_2 cross section varied as a function of ion energy in the manner generally reported. However the cross section decreased 15 percent in going from 17 to 23 ev in electron energy. This is attributed to metastable ions in the beam which transfer inefficiently. In the O_2^+ in N_2 case, for electron energies below 18 ev, the cross section vs ion energy curve was strongly non-resonant, approaching zero cross section below 100 ev. For electron energies above 22 ev, a transfer cross section was quite evident which appeared to have resonance form. The metastable states likely to produce these results are discussed along with their estimated transfer cross sections. (auth)

32469 CONCERNING THE MEASUREMENT OF CHARGE TRANSFER REACTION CROSS SECTIONS AT THERMAL ENERGIES. J. W. McGowan, P. Marmet, and L. Kerwin (Laval Univ., Quebec). p.854-61 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Measurements of charge transfer reactions between ions and atoms or molecules were generally carried out at incident particle energies greater than 10 ev. For near resonant asymmetric reactions, it is expected that at thermal energies the cross section might be large. Recent experiments have demonstrated the marked variation of cross section with the excited vibrational or electronic state of the projectile. For these reasons it is necessary that experiments be performed in the energy interval from 10 ev through thermal, in order to determine the role of excited states and to ascertain whether or not near resonant reactions have large cross sections. The 127° electrostatic electron selector was used to demonstrate charge transfer reactions in the N_2–Ar system for different vibrationally (N_2^+) and electronically (Ar^+) excited levels at thermal energies. By comparing the ionizations efficiency curve of the parent ion with one for the product, relative cross sections were estimated for various states. The results, however, are qualitative. These experiments are analyzed. (auth)

32470 RESONANT ELECTRON CAPTURE IN COLLISIONS OF Ne^+ ON Ne AND Ar^+ ON Ar. P. R. Jones, G. Van Dyk, and N. Eddy (Univ. of Massachusetts, Amherst). p.862-4 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Recent measurements show that the electron capture probability P_0 for single collisions of Ne^+ on Ne oscillates as a function of scattering angle θ at fixed incident-ion energy E. The effect is most prominent for the less violent collisions, corresponding to $E\theta < 12$ kev · deg, where P_0 oscillates between about 0.3 and 0.7. The interpretation is that the unpaired electron moves back and forth between the two nuclear sites with a variable frequency determined by the energy separation $(E_r - E_a)$. One can then infer the functional dependence of $(E_r - E_a)$ upon the inter-nuclear separation. Current measurements are for Ar^+ on Ar collisions at a few kev and down to scattering angles of 1 deg, and include also an extension of the Ne^+ on Ne data to small angles. (auth)

32471 DIFFERENTIAL AND TOTAL CROSS SECTIONS FOR CHARGE TRANSFER IN 1 kev He^+ ON He COLLISIONS. E. Everhart, H. F. Helbig, and G. J. Lockwood (Univ. of Connecticut, Storrs). p.865-70 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Differential measurements of the electron capture probability P_0 in He^+ on He collisions at 1 kev are plotted vs impact parameter and compared directly with predictions of the impact parameter method. The expected oscillations in P_0 with impact parameter are seen experimentally, and these are in good agreement with the theory as to location. However, the amplitude of these oscillations does not range from zero to unity as the theory predicts. It is noted that an important portion of the theoretical curve covers a range of impact parameter where it is actually impossible, because of the uncertainty principle, to measure the impact parameter. (auth)

32472 ION-ATOM INTERCHANGE PROCESSES. J. Sayers and D. Smith (Univ. of Birmingham, Eng.). p.871-6 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Ion-atom interchange reactions at thermal energies were reviewed and the results were summarized. (auth)

32473 RECENT DISCOVERIES CONCERNING IONS. R. N. Varney (Washington Univ., St. Louis). p.877-82 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Studies were made on ions in hydrogen, nitrogen, argon, and mercury vapor using mass spectrographic techniques and drift velocity measurements. A cross section for the formation of H_3^+ as a function of E/p was determined. A glow discharge at pressures below 2 mm Hg was formed in nitrogen and ions drawn out through holes in the cathode. Drift velocity studies show apparently a strong current of N_3^+ ions and a weaker current of N_2^+ ions. The failure of N_2^+ to form N_4^+ at low E/p is confirmed. Drift velocities of ions in mercury vapor were measured. They show only a single ion, believed to be Hg^+ rather than a molecular ion. The effect of the intensity of the discharge source of ions in argon was studied as the possible cause of the divergent observations of Biondi and Hornbeck. (auth)

32474 DIFFERENTIAL SCATTERING CROSS SECTION AND CHARGE STATE DISTRIBUTION OF AN ARGON-ION BEAM IN SINGLE COLLISIONS WITH GAS ATOMS AT 250 kev–1400 kev. L. I. Pivovar, M. T. Novikov, and V. M. Tubaev (Inst. of Physics and Tech., Khar'kov). p.883-91 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Total differential scattering cross sections of argon ions in argon and krypton were measured. The data obtained are in agreement with those computed on the assumption that elastic interactions of particles may be described by the coulomb potential with exponential screening. Energy and angle distributions of charge fractions in an argon beam of particles in single collisions with argon and krypton atoms were measured. These data agree with the theory of Russek and Thomas as well as with that of O. B. Firsov. The measurements were carried out in the angle range of 1°–3°. (auth)

32475 TRANSPORT PROPERTIES AND SCATTERING IN MOLECULAR GASES. A. Dalgarno and R. J. W. Henry (Queen's Univ., Belfast). p.914-20 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Experimental data on transport properties and scattering in molecular gases are usually interpreted assuming a spherically symmetric interaction potential and single

channel (elastic) scattering. This procedure is analyzed and shown to be justifiable as a first approximation provided it is recognized that the generalization of transport theory to molecular gases involves the replacement of elastic cross sections by total cross sections and that the beam scattering data refer to total cross sections and not elastic cross sections. The distinction between total and elastic cross sections is especially significant for ion-molecule interactions at thermal velocities, since it implies a form for the long range interaction different from that which has been adopted. Some consequences of this difference in long range behavior are described. Explicit calculations are presented for the scattering of atomic hydrogen by molecular deuterium. (auth)

32476 INTERACTION POTENTIALS FROM THE VELOCITY DEPENDENCE OF TOTAL ATOM-ATOM SCATTERING CROSS SECTIONS. E. W. Rothe, P. K. Rol, R. H. Neynaber, and S. M. Trujillo (General Dynamics/Astronautics, San Diego, Calif.). p.927-33 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The velocity (v) dependence of the total cross section (Q) was previously measured for the scattering of lithium by all the rare gases and for potassium by krypton and xenon. Assuming a Lennard-Jones potential, the depth of the interatomic potential well, ϵ, and the interatomic separation at the zero of potential energy, σ, were obtained from these measurements. From the experimental ϵ and σ, a theoretical Q(v) was computed using a partial wave analysis. Good agreement with the experimental data was obtained. The K–Kr and Li–He collisions, which were studied in the low velocity region and in the high velocity region, respectively are discussed. It is shown that ϵ and σ may be unambiguously determined in the low-velocity region. In the high-velocity region such a determination requires precision which is unattainable with the experimental arrangement. (auth)

32477 RECENT EXPERIMENTAL RESULTS OF ELASTIC SCATTERING OF HIGH VELOCITY NEUTRAL BEAMS: RELIABILITY OF DERIVED INTERMOLECULAR POTENTIALS. I. Amdur, J. E. Jordan, and R. R. Bertrand (Massachusetts Inst. of Tech., Cambridge). p.934-43 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The elastic scattering of high velocity neutral beams was used to redetermine intermolecular potentials for He–He between 0.52 and 0.98 Å and for Ar–Ar between 1.6 and 2.0 Å. At the closest internuclear separations the potentials are significantly higher than outdated values from previous experiments. Particular attention was paid to analysis of the experimental results and to assessing the importance of inelastic scattering, quantum elastic scattering, metastable beam particles, and nuclear motion. It is concluded that the results are reliable within 20 percent and that in the case of He at the smallest separations, the velocity of the beam particle may influence the apparent potential. (auth)

32478 FACTORS AFFECTING THE LONG RANGE INTERATOMIC POTENTIAL AND SCATTERING CROSS SECTION. P. R. Fontana (Univ. of Michigan, Ann Arbor). p.944-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

In most collision cross section calculations the long range interaction is approximated by the dipole-dipole (C/R^6) potential. The total cross section then depends upon $(C/v)^{\frac{2}{5}}$ where v is the relative velocity of the colliding atoms; and the differential cross section has a $\theta^{-\frac{7}{3}}$ angular dependence at moderately small angles. Presently existing discrepancies between measured and calculated total cross sections have led to a detailed investigation of the effects of other interactions on the collision cross section. In particular the following interactions were considered: dipole-quadrupole interactions and retardation effects (the $1/R^6$ potential is multiplied by a factor f(R) that becomes unity at small distances and has a 1/R dependence at large distances). The modified collision cross sections are calculated for a number of low energy atom-atom collisions. (auth)

32479 DRIFT VELOCITIES OF LOW ENERGY NITROGEN IONS IN NITROGEN. P. G. Davies, J. Dutton, and F. Llewellyn-Jones (University Coll., Swansea, Wales). p.950-4 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Preliminary results of the drift velocity of low energy nitrogen ions in nitrogen in the range $4 \leqq E/p_0 \leqq 40$ volts cm^{-1} mm Hg^{-1} and for $0.8 \leq p_0 \leqq 7.6$ mm Hg (where E is the electric field and p_0 is the gas pressure reduced to a temperature of 0°C) are given. The results indicate when taken together with those of Vogel, that ions with mobility 2.5 cm sec^{-1} per volt cm^{-1} can exist over the range $4 \leqq E/p_0 \leqq 70$ volts cm^{-1} mm Hg^{-1}. These ions are considered to be N_3^+, N_4^+ or most probably in the present work a mixture of these ions. (auth)

32480 SCATTERING OF HYDROGEN ATOMS BY DEUTERIUM MOLECULES. W. L. Fite and R. T. Brackmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.955-63 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Collisions of hydrogen atoms and deuterium molecules were studied in a crossed beam experiment. Angular distributions of scattered H were obtained and the integrated distributions were equated to known total cross sections in order to obtain absolute differential non-reactive scattering cross sections. These were then used for calibration purposes in studying reactive collisions in which $H + D_2 \rightarrow HD + D$. Although signal-to-noise problems were extremely severe, the results for the differential reactive collision cross section over a limited range of observation angles do not appear to conflict with the expected results using a rapidly-dissociating linear H–D–D complex model for the reaction process. (auth)

32481 NON-ADIABATIC EFFECTS IN HIGH ENERGY ATOMIC SCATTERING. W. R. Thorson (Massachusetts Inst. of Tech., Cambridge). p.964-71 of "Atomic Collisions Processes." Amsterdam, North-Holland Publishing Co., 1964.

There is a large discrepancy (~9 ev) between the calculated adiabatic electronic energy of the ground state ($X^1\Sigma_g^+$) of the system He_2 and the effective scattering potential deduced from experiments with high energy (2 kev) atomic beams, at small interatomic distances (R = 0.53 Å). It is shown that at least a substantial part (25%) of this discrepancy arises from non-adiabatic effects of high relative angular velocity of the atoms in the collisions typical of the experiment. A perturbation theory treatment is included to estimate the magnitude of the effect; but a variational calculation is employed with the non-adiabatic hamiltonian to produce the minimum estimates of non-adiabatic energy shifts. The theory predicts the observed approximate agreement between adiabatic energies and the experimental potentials at larger distances (R = 1.06 Å). It is likely that elaborate variation calculations that include continuum contributions will recover all or most of the discrepancy re-

maining at 0.53 Å, and will not alter the small magnitude of non-adiabaticity at 1.06 Å. (auth)

32482 ELASTIC SCATTERING OF CHEMICALLY REACTIVE MOLECULES. D. R. Herschbach and G. H. Kwei (Univ. of California, Berkeley). p.972-82 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The angular distribution and the velocity dependence of the total elastic scattering cross section are calculated for a potential which presents a deep chemical well at small distances and a Van der Waals well at large distances. A two-body central force model and semiclassical mechanics are used. It is found that the chemical well suppresses much of the wide angle scattering and under suitable conditions may introduce several special effects, including multiple rainbows and chemical orbiting in the angular distribution and beats in the undulatory velocity dependence of the total cross section. (auth)

32483 SOME PROPERTIES OF ATOM RECOMBINATION BY THREE-BODY COLLISIONS. A. Mann (Universität, Marburg, Ger.). p.988-96 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Mechanical similarity laws are utilized to relate properties of the recombination process to parameters that characterize the three particle system and its initial state. A classical model is considered with a potential energy inversely proportional to the sixth power of the separation between the two recombining atoms. This allows a classification of the atomic motion according to three parameters, characterizing scale, form, and velocity. These parameters are used as natural units in the calculation of a pattern for the recombining process. The discussion of reaction rates under specified conditions or of relations between the recombination properties of different systems and states is thereby reduced to an investigation of the respective influence on the parameters of the pattern. (auth)

32484 COLLISION PROCESSES LEADING TO OPTICAL MASERS IN GASES. C. K. N. Patel (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.1009-54 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Electronic and atomic collision phenomena which lead to optical maser action in gas discharges are reviewed. A brief description of properties of optical maser output is also given. A table of 175 maser wavelengths covering the region 5900 Å to 34μ is included. (auth)

32485 COLLISION BROADENING OF SPECTRAL LINES BY IDENTICAL ATOMS. T. M. Bieniewski (Aerospace Research Labs., Wright-Patterson AFB, Ohio). p.1055-64 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Absolute f-values were experimentally measured for the silver resonance transitions AgI $\lambda\lambda$ 3281 and 3383, and the cadmium intersystem transition CdI λ 3261. All the measurements, reported here, were made by the method of total absorption applied to weak lines on the linear part of the curve of growth and also to strong lines on the square root portion of the curve of growth. For strong lines, the measurements included the damping widths due to two separate resonance interactions: dipole-dipole collisions between identical atoms and spin re-orienting collisions between identical atoms in a weak external magnetic field. Very good agreement is obtained between the line widths and theoretically predicted widths. (auth)

32486 SATELLITE BANDS IN THE SPECTRA OF GASEOUS MIXTURES AND THE SHAPE OF POTENTIAL CURVES FOR NEUTRAL ATOMS AND MOLECULES IN THE STATE OF COLLISION. Oleg Jefimenko (West Virginia Univ., Morgantown). p.1065-72 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

An analysis of the experimental data on Cs satellite bands in the spectra of gaseous mixtures suggests the existence of auxiliary minima and relative maxima in the excited state potential curves representing binary interactions between colliding atoms and molecules. The auxiliary minima are indicated for interactions of the radiating atoms with the foreign gas molecules which cause a red shift of the atomic lines (exhibit the Ramsauer-Townsend effect). The relative maxima are indicated for interactions of the radiating atoms with the foreign gas molecules which cause a violet shift of the atomic lines (do not exhibit the Ramsauer-Townsend effect). The depth of the minima and the height of the maxima are determined primarily by the effective cross section of the foreign gas molecules for collisions with the valence electrons of the radiating atoms. The assumption of such minima and maxima leads to a plausible explanation of many properties of the alkali-foreign gas satellite bands. (auth)

32487 INELASTIC COLLISIONS OF METASTABLE ATOMS IN GASES. DISSOCIATIVE IONIZATION. E. E. Muschlitz, Jr., and M. J. Weiss (Univ. of Florida, Gainesville). p.1073-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The formation of positive ions by the Penning ionization process: $A^* + XY \rightarrow XY^+ + A + e$ or $A^* + XY \rightarrow X^+ + Y + A + e$, where A^* is a metastable atom of thermal energy and XY, a gas molecule was investigated utilizing a mass spectrometer for the identification of the product ions. Metastable helium, neon, and argon atoms incident on oxygen, methane, and ethane were studied. In nearly every case all fragment ions energetically possible are observed. The resulting mass spectra are compared with the corresponding electron impact spectra. In the case of collisions of He^* with O_2, the cross sections were determined as 10.5 $Å^2$ for the formation of O_2^+ and 3.5 $Å^2$ for the formation of O^+. (auth)

32488 DOUBLE INELASTIC COLLISIONS OF HYDROGEN ATOMS WITH EXCITED HYDROGEN ATOMS IN 2, 3, 4 STATES. D. B. Bouthilette (St. John's Univ., Jamaica, N. Y.), J. A. Healey, and S. N. Milford. p.1081-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Born total cross sections are calculated for the transitions: (1s-2s; n, l − n + 1, l') and (1s-2p; n, l − n + 1, l') with all l,l' for n = 2, and selected l,l' for n = 3,4. The case (2s-3p; 2s-3p) is also considered. The energies considered range from several Mev down to several kev. Because the atom-atom Born differential cross sections can be expressed in terms of electron-atom Born differential cross sections, previously calculated Born differential cross sections for inelastic electron collisions with hydrogen atoms are employed to reduce the amount of analysis required. At low energies, within the accuracy of the present Born calculations, some of the total cross sections for collisions of hydrogen atoms with excited hydrogen atoms are found to have two or more maxima. (auth)

32489 LOW-ENERGY ELECTRON SCATTERING FROM METASTABLE HELIUM. R. H. Neynaber, S. M. Trujillo, L. L. Marino, and E. W. Rothe (General Dynamics/

Astronautics, San Diego, Calif.). p.1089-95 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The total cross section for the scattering of electrons by metastable helium in the 2^3S state was measured at five energies between 0.87 and 8.3 ev by a d-c atomic beam recoil technique. An electron beam was cross-fired at a collimated metastable helium beam. The recoil of atoms caused by electron impact resulted in a decrease in the metastable current observed at a narrow-slit detector. This decrease was measured by an electrometer and was proportional to the desired cross section. The source of metastable atoms was a hot-cathode, a low voltage arc discharge. The beam of 2^3S helium atoms was obtained by state selection using an inhomogeneous magnet, and was detected by measuring the secondary electron current resulting from impacts of the metastable atoms on a gold surface. The experimental results are compared with theoretical estimates. (auth)

32490 VIBRATIONAL ENERGY TRANSFER IN MOLECULAR COLLISIONS INVOLVING LARGE TRANSITION PROBABILITIES. D. Rapp (Lockheed Missiles and Space Co., Palo Alto, Calif.). p.1096-1102 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Previously presented results of an exact calculation of vibrational energy transfer probabilities in molecular collisions are discussed. In the limit of low collision velocities this calculation reduces to the first-order perturbation result commonly known as the S–S–H calculation. In this velocity range, for which the absolute transition probabilities are small, the transition probabilities increase exponentially with $-K/v$, where K is a constant. At high velocities, for which the perturbation calculation gives transition probabilities that are too high (and indeed may exceed unity), the exact probabilities show oscillatory dependence on collision velocity. An average transition probability obtained by integrating the microscopic transition probability over a thermal velocity distribution will show a difference in temperature dependence at high temperatures, depending on whether one uses the approximate perturbation transition probability, or the exact transition probability. In general, the perturbation calculation overestimates the average transition probability at high temperatures. A discussion of two important aspects of this calculation is presented with particular attention to the approximations made. These aspects are the relation between the wave mechanical calculation and the semiclassical approximation used in the calculation; and the number of states that must be included in an exact calculation of transition probabilities between states. Not only are these considerations important in vibrational energy transfer, but in any calculation of transition probabilities between quantum states of a molecule induced by molecular collision. (auth)

32491 THE QUENCHING OF INVERTED POPULATIONS IN VIBRATIONAL LEVELS BY COLLISIONAL EXCITATION TRANSFER. H. Heil (Hughes Research Labs., Malibu, Calif.) and W. G. Wagner. p.1103-12 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The operation of lasers involving a vibronic or rotational transition in a molecular gas is strongly hindered by the possibility of resonant excitation transfer. Electromagnetic transfer is negligible, but collisional transfer cross sections determine whether the required population inversion can be achieved. Quantitative estimates of the pumping power needed can be obtained from a derived formula. (auth)

32492 MOLECULAR BEAM MEASUREMENTS OF INELASTIC CROSS SECTIONS FOR THE EXCITATION OF THE ROTATIONAL TRANSITION TlF (2,0) → (3,0) IN COLLISIONS WITH ATOMS. J. P. Toennies (Universitat, Bonn). p.1113-22 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

Inelastic collision cross sections for transitions between specified rotational states, designated by (J, M_J), were measured in a molecular beam apparatus. With an electrostatic four-pole field molecules in a specified rotational state are separated out of a molecular beam and focused into a gas filled scattering chamber. Molecules that were scattered by less than $\frac{1}{2}°$ are then collected in a second four-pole field, located directly behind the scattering chamber, and are analyzed for their rotational state. From the pressure dependence of the intensity in the excited state cross sections for the TlF transition (2,0)–(3,0) were measured for scattering with the rare gases. Since the transition probabilities are small for the small angle scattering observed in the experiment it is possible to use the Born approximation and obtain selection rules corresponding to the different anisotropic terms in the intermolecular potential. The rare gas results are compared with calculations based on an induced-dipole, quadrupole potential term. (auth)

32493 EXCITATION MECHANISM FOR THE $N_2(1+)$ BAND SYSTEM IN SHOCK-HEATED NITROGEN. K. K. Wray and J. Derek Teare (Avco-Everett Research Lab., Everett, Mass.). p.1123-32 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

A shock tube experiment was carried out to determine the efficiencies of N_2 and N in causing the transition $N_2(X^1\Sigma_g^+) \rightarrow N_2(A^3\Sigma_u^+)$ which involves a spin flip. Shock waves were run into $N-N_2$ mixtures ($0 \leq N/N_2 \leq 0.27$), the predissociation being accomplished by means of a pulsed discharge. The N-atom concentration was obtained by monitoring the decay of the Lewis-Rayleigh afterglow for about 50 millisec subsequent to the discharge and up to the arrival of the shock. The shock waves produced temperatures in the range 7000–18,600°K close to the shock front, after rotational relaxation. The N_2 (1+) radiation (6600 to 8000 Å) was monitored as a function of time behind the shock front. This radiation rises rapidly to a maximum and then slowly falls off toward an equilibrium level as the gas sample is cooled by vibrational excitation and dissociation. The initial slopes of the radiation histories were compared with theoretical slopes; the (A) state was assumed to be in local equilibrium with $N_2(B^3\Pi_g)$, the species which gives rise to the observed radiation. The rate constant expressions deduced for the N and N_2 catalysts in the excitation process are: $k_N = 3.7 \times 10^{-16}\, T^{\frac{1}{2}}(E/kT)^2 \exp(-E/T)$ and $k_{N_2} \leq 2.2 \times 10^{-17}\, T^{\frac{1}{2}}(E/kT) \exp(-E/kT)$ cm^3/particle · sec, where E = 6.17 ev. (auth)

32494 COLLISIONS INVOLVING METASTABLE N_2 MOLECULES IN DISCHARGES AND AFTERGLOWS IN A RARE GAS PLUS N_2. C. Kenty (General Electric Co., Cleveland). p.1133-9 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

From studies of weak discharges and their afterglows in a fairly high pressure of a rare gas plus 1% N_2 evidence was found for the existence of high concentrations ($\sim 10^{13}$ cm^{-3}) of the metastable N_2 molecules $^3\Delta_u$ and $\omega^1\Delta_u$ in Ar + N_2 and in Ne + N_2, and to a lesser extent in Kr + N_2, and for a high concentration of $^3\Delta_u$ in Xe + N_2. The Vegard-Kaplan (V-K) bands are very weak indicating a very low population of $A^3\Sigma_u^+$, notwithstanding that A is being populated at a high rate by the 1st-positive bands. The indications are that A is being destroyed by collisions with $^3\Delta_u$ and $^1\Delta_u$ in Ne + N_2

and in Ar + N_2 and by $^3\Delta_u$ in Xe + N_2. High concentrations of metastables account for the great lowering of voltage gradient when N_2 is added to pure rare gas, the energy storage of the afterglow, and the excitation of metal vapors. The observed accent on 1st-positive bands originating in v = 8 and v = 4 of B $^3\Pi_g$ is accounted for (these levels being energetically very close to $^1\Delta_u$ and B′ $^3\Sigma_g^-$) and tentatively the origin of the 2nd-positive bands in the afterglow in Ne + N_2 and Ar + N_2. Accounted for also is the fact that as the N_2 content is reduced, the intensity of the 2nd-positive decreases faster than that of the V-K's. The probability is discussed that a large fraction of the normal N_2 molecules are in vibration states of 1–3 ev energy. (auth)

32495 THE ROLE OF DELAYED PHOTON PROCESSES AND METASTABLE ATOMS IN IONIZATION GROWTH IN HELIUM. D. Kenneth Davies (Westinghouse Electric Corp., Pittsburgh), F. Llewellyn-Jones, and C. G. Morgan. p.1140-4 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

The temporal development of ionization currents in pure helium between plane parallel silver electrodes was investigated at low pressures $5 \leqq p \leqq 38$ mm Hg. For overvoltages of not more than 5%, ionization growth of small initiating currents $\sim 10^{-12}$ amp up to the glow discharge regime required times between 10^{-3} and 10^{-1} sec, indicating comparatively slow rates. Previous work has shown that the action at the cathode of diffusing metastable atoms alone is too slow to account for the observed slow growth, but that the action of unscattered photons emitted from atoms excited by the current or of positive ions created in the gas is too fast; furthermore, calculation showed that no combination of these three processes could be found which would explain quantitatively the experimental data over a wide range of $8 < E/p < 30$. As a result it was found necessary to take into consideration the action of delayed non-resonance radiation especially at the higher pressures studied. A possible source of such radiation would be that arising from metastable atoms involved in two body collisions with neutral atoms, this being pressure dependent. (auth)

32496 EXPERIMENTAL EVIDENCE ON THE DEACTIVATION BY COLLISION WITH MOLECULES IN THE GROUND STATE OF MOLECULES IN ELECTRONICALLY EXCITED STATES. R. Lunt (University Coll., London), D. Mahon-Smith, E. P. Tuffy, and S. J. B. Corrigan. p.1145-58 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964.

An analysis was made of three groups of experimental data relating to the quenching of various kinds of radiation from Townsend discharges through molecular hydrogen. It is shown that the three groups of data are explicable quantitatively in terms of the quenching of the principal radiative species by molecules unchanged by the discharge. This analysis leads to values for the quenching cross sections for the radiative species concerned. (auth)

Cosmic Radiation

Refer also to abstract 32357.

32497 P_t DISTRIBUTION OF THE SECONDARY PARTICLES OF COSMIC-RAY JETS. K. Imaeda and J. Avidan (Inst. for Advanced Studies, Dublin). Nuovo Cimento (10), 32: 1497-1504(June 16, 1964).

By appropriate variation of the parameters involved in the following P_t distributions: Planck's distribution (PD), the distribution $P_t \exp[-P_t/P_0]\,dP_t$ (LD), and the distribution $(2/\alpha^2)\exp[-P_t^2/\alpha^2]\,P_t dP_t$ (BD), a best fit was determined to the experimental P_t distribution using the χ^2-test. The results show that the experimental distribution may be fitted in a satisfactory manner to the theoretical distributions (PD) and (LD), but not to (BD). The average values of P_t and the parameters obtained are 296, 308, and 292 Mev/c, corresponding to kT = 0.122 Bev, p_0c = 0.154 Bev, and α = 0.387 Bev/c, respectively. The parameters for the high-energy group and the low-energy group show no significant difference, and P_t remains constant for different values of the primary energy. (auth)

32498 COSMIC-RAY INTENSITY MEASUREMENTS DEEP UNDERGROUND AT DEPTHS OF (800 + 8400) m.w.e. S. Miyake, V. S. Narasimham, and P. V. Ramana Murthy (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 32: 1505-23(June 16, 1964).

The variation of vertical cosmic-ray intensity with depth was measured at 800 to 8400 m from the top of the atmosphere. Counter telescopes with plastic scintillator layers and Geiger counter trays kept in the horizontal plane and in coincidence were used. The experiment was carried out in the Kolar Gold Fields (Mysore State, India). The results obtained at depths of 816, 1812, 3410, 4280, 6380, and 8400 mwe are given. (auth)

32499 ENERGY SPECTRUM OF COSMIC-RAY MUONS AT SEA LEVEL. S. Miyake, V. S. Narasimham, and P. V. Ramana Murthy (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 32: 1524-40(June 16, 1964).

The integral energy spectrum of cosmic muons at sea level in the energy range from 200 to 7500 Bev was derived from the previously obtained results on the variation of vertical cosmic-ray intensity with depth in the range (800 + 8400)mwe. The effect of fluctuations in the energy losses of muons was taken into account. The muon energy spectrum obtained is compared with direct magnet spectrograph observations and with the muon energy spectrum obtained by the Bristol group from their observations on gamma cascades at high altitudes. The exponents of the integral production spectra of parents of muons are given, and an upper limit to the energy losses of muons in nuclear collisions is set. (auth)

32500 OBSERVATIONS ON EXTREMELY-HIGH-ENERGY NUCLEAR EVENTS WITH EMULSION CHAMBERS EXPOSED ON MT. CHACALTAYA. [PART] II. C. M. G. Lattes, C. Q. Orsini, I. G. Pacca, M. T. Da Cruz, E. Okuno, Y. Fujimoto, S. Hasegawa, and K. Yokoi (Universidade de São Paulo, Brazil). Nuovo Cimento (10), 33: 680-701(Aug. 1, 1964).

The results of emulsion chamber exposures at Mt. Chacaltaya (altitude 5200 m) are described and analyzed. The gamma energy spectrum is obtained for the energy region 2×10^{11} ev $< E < 8 \times 10^{13}$ ev. The results are consistent with a power spectrum with exponent $\gamma = 1.8 \pm 0.2$. Eight nuclear interactions produced in the atmosphere by primaries of energy $> 8.10^{14}$ ev are analyzed in detail. (auth)

32501 MEASUREMENTS OF LOW-ENERGY PROTONS AND ALPHA PARTICLES IN THE COSMIC RADIATION. J. Ormes and W. R. Webber (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 13: 106-8(July 20, 1964).

Balloon flight measurements, made in 1963 at Minneapolis, Ft. Churchill, and Devils Lake, of proton and alpha particle intensities in the range 100 to 1200 Mev, at various latitudes at the top of the atmosphere, are reported. The separation of the true primary protons from the background of secondary, re-entrant, and splash albedo protons was obtained, using a telescope detector consisting of scin-

tillation counter and a combination Cherenkov-scintillation counter. Data from the three flights are tabulated, and the individual primary proton and alpha spectra are shown. (L.B.S.)

32502 HYDROGEN AND HELIUM NUCLEI IN THE COSMIC RADIATION. P. S. Freier and C. J. Waddington (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 13: 108-9(July 20, 1964).

Measurements of low-energy protons and alpha particles with rigidities of 0.38 to 1.15 Bev and 0.70 to 4.0 Bev, respectively, using a nuclear emulsion detector, are reported. The differential rigidity spectra at the top of the atmosphere, with helium nuclei normalized to the higher rigidity protons, show a definite and distinct splitting of the proton and alpha spectra; but proton and alpha intensities fall sharply below some characteristic rigidity. (L.B.S.)

32503 FLUCTUATION OF COSMIC-RAY INTENSITY IN STRATOSPHERE INDUCED BY SOLAR PROCESSES. A. I. Charakhch'yan. Usp. Fiz. Nauk, 83: 35-62(May 1964). (In Russian)

Two types of cosmic ray fluctuations are analyzed, large solar-flare induced increases and small fluctuations of galactic origin. The 27 day variations with 5 to 10% amplitudes, sudden decreases in intensities during magnetic storms, and Forbush decreases with 30 to 40% amplitudes were studied, as well as the century long variations related to the 11-year solar activity cycle. 65 references. (R.V.J.)

32504 THEORETICAL AND EXPERIMENTAL ASPECTS OF COSMIC RAYS. Leverett Davis, Jr. (California Inst. of Tech., Pasadena). p.486-521 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The observed characteristics of cosmic rays, the magnetic structure of the galaxy, theories of the origin of cosmic rays, cosmic rays in the solar system, and interplanetary magnetic fields are discussed. (C.E.S.)

32505 CHARGED PARTICLE DETECTION EXPERIMENTS IN THE TRAAC SATELLITE. C. O. Bostrom, D. J. Williams, and G. F. Pieper (Johns Hopkins Univ., Silver Spring, Md.). 4p. (CONF-402-5)

From American Geophysical Union 43rd Annual Meeting, Washington, D. C., Apr. 1962.

The semiconductor detectors deployed on the TRAAC satellite for charged particle spectroscopy are described. Detection characteristics of the counters are presented. (T.F.H.)

Criticality Studies

32506 (DP-868) COMPARISON OF A SIMPLE THEORETICAL TREATMENT OF CRITICAL ARRAYS OF FISSIONABLE UNITS WITH EXPERIMENT. H. K. Clark (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1964. Contract AT(07-2)-1. 28p.

Calculations of the critical sizes of cubic arrays of interacting fissionable units are compared with critical experiments. The units were of two types: vessels containing 5 liters of an aqueous solution of highly enriched uranium and cylinders of highly enriched uranium metal. The arrays were surrounded by various thicknesses of hydrogenous reflectors. Agreement between calculation and experiment is reasonably good when consideration is given to the simplicity of the method of calculation. Curves are presented for computing critical sizes of cubic arrays of 8, 27, 64, or 125 identical units as a function of the albedo of the reflector surrounding the array and of the reactivity of an individual unit. (auth)

Direct Energy Conversion

Refer also to abstracts 31995, 32892, and 33052.

32507 (A/CONF.28/P/217) ISOTOPIC POWER SOURCES COUPLED WITH THERMOELECTRIC CONVERTERS. J. G. Morse (Martin Co., Baltimore) and D. G. Harvey. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The factors affecting design of radioisotope powered thermoelectric converters are described, and technology status and areas for broader use are indicated. 11 references. (T.R.H.)

32508 (A/CONF.28/P/218) REACTOR DIRECT-CONVERSION UNITS. H. M. Dieckamp (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), R. Balent, and J. R. Wetch. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The SNAP 10A 500-watt reactor system is described. The discussion topics are: reactor, power conversion, system, safety, and reactor-thermoelectric system performance. (T.R.H.)

32509 (AD-602285) THERMIONIC CONVERTER LIFE AND REPEATABILITY INVESTIGATION. Quarterly Progress Report No. 2, April 1–June 30, 1964. C. Z. Kamien (Thermo Electron Engineering Corp., Waltham, Mass.). Contract AF33(615)-1348. 32p. (TE-4-65)

The fabrication and test of two series 400 thermionic converters and the fabrication of two additional converters are discussed. The testing of converter prototype 401-P-1 yielded an output of 13 watts at 0.7 volt (6.5 watts/cm^2). The results of repairable converter prototype 402-R-1 are 30 watts at 0.7 volt (15 watts/cm^2). The gas-sampling unit is being tested. The first of four life-test setups is completed, and the description of the unit is presented. (auth)

32510 (GIC-2605-2) DEVELOPMENT TECHNIQUES FOR POWER PRODUCTION FROM MIXED FISSION PRODUCTS. Phase III Interim Report. E. J. Lemanski (General Instrument Corp. Thermoelectric Div., Newark, N. J.). July 1963. Contract AT(30-1)-2605. 129p.

A description is presented of work done during the Phase III program in the development of techniques for power production from mixed fission products (Oct. 1962 through June 1963). The program for fabrication of an MFP-fueled 5- to 10-watt thermoelectric generator for "hot" fueling includes project administration, system analysis and design, component tests, and fabrication and assembly. (R.E.U.)

32511 (GIC-3362-1) BISMUTH TELLURIDE IMPROVEMENT PROGRAM. LITERATURE SURVEY. A. S. Gelb (General Instrument Corp., Newark, N. J.). June 1964. Contract AT(30-1)-3362. 89p.

Bi_2Te_3, Bi_2Se_3, Sb_2Se_3, Sb_2Te_3, bismuth-antimony-tellurium, bismuth–selenium–tellurium, $Sb_2Bi_{2-x}Te_{3-y}Se_y$, and $Bi_{24}Se_6Sb_{60+x}Te_{150-x}$ alloys are discussed in this review of the literature with particular emphasis on elevated temperature properties. Bi_2Te_3 is useful thermoelectric material which is capable of being doped n-type with Groups I, II, III, and VI elements or p-type with Groups IV and V elements. As grown, Bi_2Te_3 is p-type due to a tellurium deficient lattice. Due to limited solubility of most of the donor impurities, however, compound doping

is usually employed. The iodides and bromides of copper and silver are used extensively. The figure of merit of Bi_2Te_3 normally peaks at or slightly above room temperature. In general the halides function as donors and silver, copper, zinc, cadmium, tin, lead, and iron as acceptors in a $Bi_2Te_3-Sb_2Te_3$ alloy. Elements of Groups II, III, IV, V, and VIII act as acceptors and the halogens, halides, copper, silver, tellurium, and selenium as donors in a $Bi_2Te_3-Bi_2Se_3$ alloy. The high temperature properties of the $Bi_2Te_3-Sb_2Te_3$ and $Bi_2Te_3-Bi_2Se_3$ alloys can be controlled to a greater extent than in Bi_2Te_3 by varying the bismuth/antimony or tellurium/selenium ratio. The maximum figure of merit is shifted to higher temperatures by increasing the carrier concentration. The addition of Sb_2Se_3 to a $Bi_2Te_3-Sb_2Te_3$ alloy increases the band gap and produces a material useful to higher temperatures. The bismuth–antimony–selenium–tellurium system is studied. A bibliography containing 453 references is included and contains information through 1964. (auth)

32512 (JUL-144-PC) ELEKTROCHEMISCHE KERNENERGIE-KONVERTER. (Electrochemical Nuclear Energy Converter). G. Grueneberg (Kernforschungsanlage. Institut fur Physikalische Chemie, Julich, Germany). Jan. 1964. 47p.

The direct conversion of nuclear energy into electricity is generally restricted to purely physical methods in the literature. The information presently available on electrochemical methods is reviewed. In these processes the nuclear energy is primarily converted into chemical energy. The radiation products are used in specially adapted galvanic cells. An important example is the charging of cells with H_2-O_2 mixtures that are formed in water-moderated reactors. An estimate of the conversion efficiency of the different electrochemical methods is possible by use of the results of radiochemical investigations. The regenerative oxygen–ozone cell with an efficiency factor of 15 to 25% should be of special technical interest. The regenerative hydrogen–ferric ion cell is also competitive with physical conversion methods. The possible use of a ^{235}U homogeneous reactor as a galvanic cell is briefly discussed. (tr-auth)

32513 (MND-3149-1) THERMIONIC DOUBLE-DIODE PROGRAM. Quarterly Technical Progress Report, March 16–June 15, 1964. (Martin-Marietta Corp. Aerospace Div., Baltimore). June 30, 1964. Contract AF33 (615)-1289. 23p.

Engineering design of the improved double-diode module was completed. Design refinements and improvements on the fueled emitter design, module configuration, design features affecting performance, manufacturing techniques, and instrumentation were incorporated into the previous double-diode module design. Fabrication of components for the modules and test fixtures and instrumentation was initiated. Fabrication of the fueled emitters for the thermal endurance and vacuum tests was started. (auth)

32514 (NP-14068) RADIOISOTOPE THERMOELECTRIC POWER SYSTEMS. E. T. Allen (Westinghouse Electric Corp. Aerospace Electrical Div., Lima, Ohio). Feb. 1, 1963. 44p. (D-709582)

Radioisotope-fueled thermoelectric generators for supplying electrical power for space vehicles are reviewed. The following topics are discussed: (1) thermoelectric generators utilizing convective heat transfer; (2) thermoelectric generators utilizing conductive heat transfer; (3) systems requiring decreasing amounts of power as a function of mission life; (4) systems requiring constant power as a function of mission life; (5) curium-242, polonium-210, curium-244, and plutonium-238 as alpha emitters; (6) cesium-144, cobalt-60, strontium-90, and cesium-137 as beta and gamma emitters; and (7) the design of a 60-watt thermoelectric generator. (R.E.U.)

32515 (TE-29-64) SURFACE AND ADSORBATE STUDIES. Quarterly Report No. 2, June 25–September 25, 1963. D. Lieb, S. S. Kitrilakis, and J. H. Weinstein (Thermo Electron Engineering Corp., Waltham, Mass.). Contract NAS-3-2539. 50p.

The measurements taken of the emission from a polycrystalline molybdenum surface, using a photoelectric scanning device are described. The measurements were made with cesium only in the tube and then repeated with cesium plus cesium fluoride. The data were correlated along Rasor plots (ϕ versus T/T_R) and it was shown that the fluoride additive causes the same type of shift in the value of T/T_R when ϕ goes through a minimum, as was observed in converter testing with additives. Since the two measurements are based upon completely different types of experiments, the parallelism of the results is of considerable significance. The physical principles involved in photoelectric and thermionic scanning, and in the reduction of the data to useful forms, are described. Examples are given. The experimental work to be performed is described. (auth)

32516 (FTD-TT-64-528) PROBLEM OF THERMIONIC CONVERSION OF HEAT INTO ELECTRICITY. Jaroslav Kramar. Translated from Elektrotech. Obzor, 52: 513-18(1963). 21p.

The effects of the characteristic magnetic field due to the current in a thermionic cell, space-charge effects, and direct generation of a-c are discussed for plain, parallel, and coaxially arranged plate-type electrodes. Vacuum tightness and emitter life are also discussed. (R.E.U.)

32517 CALCULATION OF THE DIRECT-CHARGE NUCLEAR CURRENT SOURCES. A. A. Kononovich, M. G. Mitel'man, and N. D. Rozenblyum. At. Energ. (USSR), 16: 351-3(Apr. 1964). (In Russian)

In view of the importance of the direct-charge method for the problem presented by the transformation of the radioactive radiation energy into electrical energy, an attempt was made to derive a general method for calculating the direct-charge voltage source. Action of such a source involves the collection of primary β-particles of the radioactive isotope in the emitter on the collector. The charging current creates a potential difference between the electrodes, kept in vacuum; it depends on the β-particle spectrum of the radioactive preparation used, the charge on the electrodes of the source, the geometry of the system, the current leakage of the induced secondary β-emission and the self-absorption of the β-particles in the layer. This last factor reduces the activity of the preparation and shifts the maximum of the spectrum toward the high-energy side. A formula was derived, taking into account the effect of the above factors. This formula was applied for the case of ^{147}Pm containing 1 mg/mc additives. The self-absorption layer amounted to 17.6 mg/cm^2. The charge current was obtained by graphic integration. It was found that at large leakage resistances ($R > 10^{15}$) the relative effect of the collector material and of the resistance on the voltage decreases with increasing resistance R. The charging velocity of the nuclear source is controlled by its capacity and by the difference between the resistances of the charge and leakage currents. (TTT)

32518 SEPARATED LIQUID DRIVEN VORTEX MHD GENERATOR. C. H. Marston. 10p. (CONF-542-3)

From 5th Symposium of the Engineering Aspects of Magnetohydrodynamics, Cambridge, Mass., Apr. 1964.

An analysis is presented of the operation, characteristics, and stability of the Separated Liquid-Driven Vortex concept for MHD power generation. In the generator, a cylindrical annulus of liquid metal flows tangentially in a radial magnetic field, thus setting up an axial electric current. Flow is produced by injecting a very-low-quality vapor-liquid stream tangentially at the inner (free) surface of the annulus. The excess vapor is allowed to escape through the ends of the cylinder, and the liquid is removed by diffusion through a porous wall at the outside of the annulus. (T.F.H.)

32519 A HYPERSONIC PLASMA POWER GENERATOR. K. J. Touryan (Sandia Corp., Albuquerque, N. Mex.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-449, 15p. $1.00. (CONF-600-11)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

A power generation technique in which hot plasma is obtained behind the ionizing bow shock of a hypersonic vehicle in a reentry trajectory is described. The vehicle nose cone serves as a hot emitter and the afterbody as a relatively cool collector, separated by a thin electric insulator. The emitted electrons are conducted through the shock-ionized air stream, increased in kinetic energy by collisions, and collected over the collector. A load connection between the cathode and the anode within the vehicle completes the circuit. (C.E.S.)

32520 NON-EQUILIBRIUM IONIZATION IN MPD POWER GENERATION-THEORY AND EXPERIMENT. Mostafa E. Talaat (Advanced Power Technology Co., Inc., Bethesda, Md. and Univ. of Maryland, College Park). New York, American Inst. of Aeronautics and Astronautics, 1964, 7p. $1.00. (CONF-600-15)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Experimental results obtained from the closed-loop magnetoplasmadynamic (MPD) power generation research facility are presented. The results are compared with the theory of non-equilibrium ionization considering collisional ionization processes from the ground state or from the resonance excited states. These excited states exist as a result of the absorption by the cesium seed atom density of the spectral radiation emitted by the MPD duct walls over the broad resonance bandwidths of the two atomic cesium resonance lines. (C.E.S.)

32521 PLASMA DIAGNOSTICS FOR MAGNETOPLASMADYNAMICS POWER GENERATION. Richard T. Schneider (General Motors Corp., Indianapolis). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-380, 11p. $1.00. (CONF-600-37)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Plasma diagnostics for closed-loop magnetoplasmadynamic power generators are discussed. The working fluid is helium seeded with cesium. The spectroscopic methods used are described. (C.E.S.)

32522 NON-EQUILIBRIUM IONIZATION IN WET ALKALI METAL VAPORS. John Marlin Smith (General Electric Co., Philadelphia). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-381, 5p. $1.00. (CONF-600-42)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Non-equilibrium ionization is investigated in wet alkali metal vapors in which the condensate is considered to be in the form of homogeneously dispersed droplets of uniform but arbitrary size. The media are considered to consist of neutral atoms, positively charged atomic ions, electrons, and liquid droplets that are negatively charged. The percent moisture is an arbitrary input parameter so that electron conduction can be evaluated in the presence of supersaturated or superheated vapor conditions. The droplet size is left arbitrary which allows the investigation of conduction at the onset of condensation when the droplets are small or at later phases where the droplets grow to large sizes. The result is the evaluation of the local scalar conductivity and with application to the MHD generator the magnetic field required to produce the considered electron temperature. (C.E.S.)

32523 A PROCESS FOR MAKING A THERMIONIC CONVERTER AND A THERMIONIC CONVERTER MADE BY THE PROCESS. (to Siemens-Schuckertwerke AG). British Patent 962,383. July 1, 1964. Priority Date Mar. 16, 1962, Germany.

A process of constructing a thermionic converter with improvements in obtaining a gas-tight seal of the electrodes is described. (L.B.S.)

32524 ENERGY CONVERTER. Harry Huber and Didier Grauleau (to CSF-Compagnie Generale de Telegraphie Sans Fil). U. S. Patent 3,139,542. June 30, 1964. Priority date Mar. 23, 1961, France.

A coaxial cylindrical thermoelectric diode is described that dispenses with spacers for the electrodes. The cylinders in the cold states fit closed to one another, and upon application of heat, a suitable gap is formed by natural expansion. Emitter materials such as niobium, tantalum, molybdenum, or tungsten, and collector materials such as titanium, beryllium, or copper are considered. (R.E.U.)

32525 NUCLEAR MAGNETOHYDROELECTRIC GENERATOR. George H. McLafferty (to United Aircraft Corp.). U. S. Patent 3,140,410. July 7, 1964. Filed July 22, 1960.

A magnetohydroelectric generator is described in which the working fluid contains fissionable materials that are made critical in the region where electric power is extracted. The fission heat is used to raise the temperature of the work fluid, which may contain uranium and seed materials. (R.E.U.)

32526 A.C. NUCLEAR GENERATOR. Charles Oickle, Jr. and Edward A. Pinsley (to United Aircraft Corp.). U. S. Patent 3,140,411. July 7, 1964. Filed Sept. 12, 1960.

A magnetohydroelectric generator is described in which the working fluid contains fissionable materials that are made critical in a region of power extraction. The criticality conditions are varied periodically to produce alternating current. (R.E.U.)

32527 A CONDUCTION-TYPE MAGNETOGASDYNAMIC GENERATOR. D. A. But. Russian Patent 159,584.

A conduction-type magnetogasdynamic generator with electrodes in the form of two coaxial cylinders is described. The exterior electrode was made of isolated sections, the number of which equaled the number of poles, in order to increase the reliability. (OTS)

Elementary Particles and Radiations

Refer also to abstracts 32412 and 32664.

32528 (IFA-HE-53) HIGH-ENERGY BEHAVIOUR OF THE STRANGE PARTICLE PHOTO- AND ELECTROPRODUCTION. El. C. Mihul and D. B. Ion (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). Feb. 28, 1964. 17p.

The asymptotic behavior at high energies of strange-particle photo- and electroproduction processes is discussed. Using the multipole expansion, the expressions of forward and backward interaction amplitudes for photo- and electroproduction are obtained in Regge pole hypothesis. Only the experimentally discovered resonant states are taken into account. (auth)

32529 (ISS-64/12) INTRODUZIONE ALLA TEORIA DEI GRUPPI E ALLE SIMMETRIE UNITARIE (CICLO DI LEZIONI TENUTE DA L. MAIANI E G. DE FRANCESCHI). PARTE I. APPUNTI ALLE LEZIONI SULLA TEORIA DEI GRUPPI. (Introduction to Group Theory and Unitary Symmetries (A Course of Lectures Given by L. Maiani and G. De Franceschi). Part I. Group Theory). L. Maiani (Italy. Istituto Superiore di Sanita, Rome). Apr. 20, 1964. 34p.

The notes of a series of lectures on the theory of groups and unitary symmetry models are presented. The main results of group theory and of the theory of group representations are reviewed. Because of the applications of semisimple compact Lie groups to the physics of strongly interacting particles, particular attention is paid to them. (auth)

32530 (JINR-P-1634) POLYARIZOVANNAYA PROTONNAYA MISHEN V OPYTAKH S CHASTITSAMI VYSOKIKH ENERGII. (A Polarized Proton Target for Experiments with High-Energy Particles). S. M. Bilenky, L. I. Lapidus, and R. M. Ryndin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 80p.

Uses of a polarized-proton target in high-energy physics are discussed. Nucleon-nucleon scattering, meson (π)-nucleon scattering, and the problem of determining the strange particle parities in experiments with the polarized proton target are treated in much detail. The symmetry principles are considered, and the main theorems used in studying the polarization phenomena are given. (auth)

32531 (LAL-1111) COINCIDENCE MEASUREMENT OF ELECTROPRODUCTION OF π^0. J. P. Perez y Jorba, P. Bounin, and J. Chollet (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélérateur Linéaire). July 1964. 9p.

Coincidence methods and results for $e + p \rightarrow e + p + \pi^0$ at 470 Mev are discussed. (R.E.U.)

32532 (LNF-64/15) POSSIBLE DETERMINATION OF THE η^0 LIFETIME WITH ELECTRON-POSITRON COLLIDING BEAMS. Note No. 239. E. Celeghini and R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Apr. 24, 1964. 10p.

It is shown by a study of reaction mechanisms that the η^0 lifetime may be deduced from colliding beam experiments: $e^+ + e^- \rightarrow \eta^0 + \gamma$ and $e^+ + e^- \rightarrow \eta^0 + \pi^+ + \pi^-$. (R.E.U.)

32533 (NP-13936) RENORMALIZATION OF β- AND μ-DECAY CONSTANTS IN THE THEORY WITH INTERMEDIATE W-MESON. B. L. Ioffe (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii. Institut Theoreticheskoi i Eksperimental'noi Fiziki, Moscow). 1964. 12p.

Renormalization of β- and μ-decay constants due to the electromagnetic interaction of W-mesons is investigated for anomalous magnetic moments $\gamma = 0$ and $\gamma \neq 0$ by means of ξ-formalism developed by Lee and Yang in an attempt to account for contributions of the most strongly divergent terms in approximations of perturbation theory in powers of e^2. Strong interaction of the nucleons is considered, and the integrals over the momenta of virtual strongly interacting particles is cut off at momenta of the order of nucleon mass. (R.E.U.)

32534 (NP-13989) STRUKTURA j-PLOSKOSTI VBLIZI j = 1 I DIFFRAKTSIONNOE RASSEYANIE PRI VYSOKOI ENERGII. (The Structure of j-Plane Near j = 1 and Diffraction Scattering at High Energies). V. N. Gribov (Akademiya Nauk S.S.S.R. Fiziko-Tekhnicheskii Institut im. A. F. Ioffe, Leningrad); I. Ya. Pomeranchuk, and K. A. Ter-Martirosyan (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1964. 48p.

The effects of partial wave branching in the j-plane on the asymptotics of diffraction scattering amplitudes at high energy are analyzed. The main asymptotic problem is described by $j = j_n(t) = n\alpha(t/n^2) - n + 1$ (where $\alpha(t)$ is right pole trajectory). (R.V.J.)

32535 (NP-14081) SLABOVZAIMODEISTVUYUSHCHII VEKTORNYI BOZON I PERENORMIROVKA KONSTANT β- I μ-RASPADA. (Weakly Interacting Vector Boson and a Renormalization of the Constants of β and μ Decay). B. L. Ioffe (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 35p.

In the theory of weak interaction with intermediate vector boson W the renormalization of β and μ decay constants due to the electromagnetic and weak interactions is investigated. It is shown that at zero γ-anomalous magnetic moment of the W-meson, the radiation corrections to the ratio G_μ/G_β are of the order $e^2 \ln e^{-2}$ and at $\gamma \sim 1$, of the order $\sqrt{e^2}$. At $\gamma = 0$ the radiation correction is calculated with the account of the terms $\sim e^2 \ln e^{-2}$ but disregarding the terms $\sim e^2$. The corrections due to the weak interaction are small if the W-meson mass does not exceed several Bev. (auth)

32536 (NP-14090) K TEORII RASSEYANIYA ELEKTRONOV I FOTONOV V OBLASTI BOL'SHIKH ENERGII. (The Theory of Electron and Photon Scattering in the Region of High Energies (thesis)). S. S. Sannikov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1963. 158p.

The theory of two-component spinor fields, free Weyl fields, the Green function, field interactions and matrix scattering, and the spiral rule are considered. Interactions of spiral electrons and positrons are discussed. Electron and positron scattering, photon scattering by a spiral electron, photon emission on collisions of spiral electrons and positrons, and pair production are described. Photon-photon scattering at high energies—dispersion relations and differential and total cross sections—are covered. The inelastic scattering of a photon in the Coulomb field of a nucleus is discussed. (M.J.T.)

32537 (PPAD-304D) AN EXPERIMENT TO DETERMINE (g – 2) FOR THE FREE MUON. Glen Schrank (Princeton-Pennsylvania Accelerator, Princeton, N. J. and Princeton Univ., N. J. Palmer Physical Lab.). Mar. 29, 1960. Contract [AT(30-1)-937]. 58p.

General considerations for determining the properties of mesons (μ) and an experiment for determining the g-factor are described. (R.E.U.)

32538 THE γ-RADIATION SPECTRUM AND THE PARTIAL VALUES OF THE ABSORBED ENERGY IN AN ARBITRARY HOMOGENEOUS MIXTURE. V. A. El'tekov, B. M. Terent'ev, and M. V. Panchvidze. At. Energ. (USSR), 16: 291-5(Apr. 1964). (In Russian)

Calculation of the γ-ray spectrum in a homogeneous medium containing uniformly distributed radiation sources presents the advantage that the results are obtained in the form of a quadrature for any given material or mixture. The authors et al (Zhur. Eksper. i Tekhn. Fiz. 31: 837 (1961); Atomnaya Energ. 13: 568(1962) NSA 17: 13355) have shown previously that by means of the age approximation method, results close to the exact values may be obtained in the case of hard quanta ($\lambda < 1$, where λ represents a dimensionless wavelength) when calculating the distribution of the absorbed γ-radiation between the components of a given quasi-homogeneous mixture. Reviewing the approximation methods which include the transition from the exact integral equation defining the γ-quantum density to a first order differential equation, it was found that various indefinite functions may be used as coefficients of the latter equation. The solution derived by P. Karr and J. Lamkin (Phys. Rev. 76: 1843(1949) NSA 4: 1300) was compared with the results obtained by the approximation methods. The derived formula was used to compute the energy distribution between the radiation sources consisting of 22 vol.% In and 78 vol.% Ga and irradiated material which was taken as a water-equivalent liquid, in an In–Ga loop. The results agreed well with those obtained by Monte-Carlo calculations. The various deviations from the actual spectral density appeared to compensate each other. (TTT)

32539 ON THE HIGH ENERGY BEHAVIOR OF STRONG INTERACTION. Ying Chuan Yang (National Tsing Hua Univ., Taiwan). Chinese J. Phys. (Taiwan), 2: 46-7(Apr. 1964).

A model is proposed in which the boson radiative corrections to the two-body scattering amplitude yield characteristics resembling Regge poles in the high energy limit. Virtual and real boson radiative corrections are derived for interactions of particles accelerated in vector potential fields carried by isospin, hypercharge, and baryon currents. (M.J.T.)

32540 APPLICATION OF THE MEASUREMENT AND CALCULATIONS OF MULTIPLE SCATTERING IN SMALL CELLS TO ANTIPROTON TRACKS AT THE PATH END, OBSERVED IN NUCLEAR EMULSIONS. Denise Schune-Boisble, Jeannine Fitan, and Tsai-Chu (Laboratoire de Physique-Enseignement, Paris). Compt. Rend., 258: 4959-62(May 20, 1964). (In French)

Measurement of multiple scattering in 5-μ cells on antiproton tracks permitted the detection of antiprotons annihilated in flight before the end of the path. The multiple scattering constant for the center-of-gravity method is of the same order as the theoretical value. (tr-auth)

32541 THE REACTIONS $e^+ + e^- \rightarrow 2\gamma$ AND $e^+ + e^- \rightarrow \mu^+ + \mu^-$ AND THE POSSIBILITIES OF VERIFYING THE VALIDITY OF QUANTUM ELECTRODYNAMICS AT SHORT DISTANCES. Pham Xuan Yem. Compt. Rend., 258: 5171-3(May 25, 1964). (In French)

The two reactions $e^+ + e^- \rightarrow 2\gamma$ and $e^+ + e^- \rightarrow \mu^+ + \mu^-$, which permit, in connection with Bhabha scattering, a test of the validity of quantum electrodynamics at short distances were studied. For energies from 200 to 400 Mev in the center-of-mass system the cross sections have a displacement from 7 to 15% with respect to the predictions of local electrodynamics, including radiative corrections. This displacement depends not only on the extinction Λ but also on the choice of the form factors. (tr-auth)

32542 PHOTON EMISSION FROM IRRADIATED DIELECTRIC SLABS. J. C. Ashley and R. H. Ritchie (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 35: 2313-21 (Aug. 1964).

A simple derivation is given of the distribution of photons emitted when an energetic charged particle passes through a thin layer of dielectric material. This derivation emphasizes the individual microscopic events that occur during such a process. The distribution function is shown to agree with that obtainable from the transition radiation theory of Frank and Ginzburg and from the plasmon decay theory of Ferrell for the case of a thin foil. The special case of a double foil bounded by vacuum is considered in detail, and a general formula is found for the photon distribution function. An approximation analogous to that of Born's in quantum mechanics is developed to treat the case of a general composite foil whose thickness is small compared with λ but which may be large compared with $v\lambda/c$, where λ is the wavelength of the light emitted and v is the speed of the charged particle. (auth)

32543 ON THE OBSERVATION OF THE Ω^- BARYON. M. Froissart and M. Jacob (Centre d'Etudes Nucleaires, Saclay, France). J. Phys. (Paris), 25: 317-18(Mar. 1964). (In French)

The prediction of a baryon Ω^- with strangeness, isotopic spin, charge, and mass of –3, 0, –1, and 1675 Mev, respectively, is examined within the framework of the octet model of unitary symmetry. Use of the mass formula as a guide to its experimental verification is shown to be inconsistent. (D.C.W.)

32544 ON BREMSSTRAHLUNG IN MUON-PROTON SCATTERING EXPERIMENTS AT HIGH MOMENTUM TRANSFER. Jean-Marie Abillon and Paul Kessler (College de France, Paris). J. Phys. (Paris), 25: 359-60 (Mar. 1964). (In French)

The radiative correction in muon-proton scattering was recalculated for various experimental conditions, taking into account the form factors recently determined by Hofstadter for momentum transfer up to 1 Bev/c. Numerical results are included. (auth)

32545 A LITTLE ORDER IN THE PHYSICS OF "ELEMENTARY" PARTICLES. Jean-Marc Lévy-Leblond. Nature (Paris), No. 3350, 201-7(June 1964). (In French)

The need for a valid classification scheme of elementary particles is indicated. The classification of the classical particles into multiplets is discussed. The unstable particles already detected and the search for additional unstable particles are surveyed. The Gell-Mann and Ne'eman classification scheme — unitary symmetry or the eightfold way — is described. The experimental confirmation of this classification scheme is reviewed. (J.S.R.)

32546 SOME CONSEQUENCES OF THE ASSUMPTION OF A NONANALYTIC CUT OFF FUNCTION. A. Rimini (Universitâ, Trieste, Italy). Nucl. Phys., 58: 9-16 (Sept. 1964).

Some consequences of the assumption of a cut off function with fractional power zeros in the Lee model are investigated. The behavior of the T matrix, scattering phase shift, and cross section are given. The modulus of the T matrix and the cross section turn out to be continuous, but the T matrix and the phase shift may have jumps at the energies where the cut off function vanishes. The Levinson theorem turns out tc be valid provided the jumps of the phase shift are suitably chosen. (auth)

32547 MEASUREMENT OF CIRCULAR POLARIZATION OF BREMSSTRAHLUNG IN ELECTRON DIFFUSION IN THICK ABSORBERS. S. Galster (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Nucl. Phys., 58: 72-80(Sept. 1964). (In German)

The circular polarization of bremsstrahlung produced in thick absorbers by β particles is a function of the atomic number of the absorber. Some authors report that the EB polarization is also dependent on the magnitude of the electric or magnetic fields within the absorber. It is shown that the Z dependence of EB polarization is a second-order effect of electron diffusion in thick absorbers in contrast to other explanations which require a modification of the primary EB production process. The electric field dependence of the EB polarization was not found within an error of ±2%. (auth)

32548 ANGULAR DISTRIBUTION OF K^--P AT 400 Mev/c. M. D. Warty (Univ. of Delhi). Nucl. Phys., 58: 113-21(Sept. 1964).

The formulas for angular distribution of K-P scatterings are presented. The calculations are made at 400 Mev/c for K^--P scattering to find whether the resonance of mass 1520 Mev is a $P_{\frac{1}{2}}$ or a $D_{\frac{1}{2}}$ resonance. The conclusion is in agreement with the experiments of Ferro-Luzzi, Tripp and Watson that the resonance is in the $D_{\frac{1}{2}}$ state. (auth)

32549 THE HYPERON-NUCLEON INTERACTION. P. A. Protopapadakis (Imperial Coll. of Science and Tech., London and Nuclear Research Center "Democritus," Aghia Paraskevi Attikis, Athens). Nuovo Cimento (10), 32: 1584-1604(June 16, 1964).

The hyperon (Λ,Σ)-nucleon interaction is studied considering the exchange of one pseudoscalar and one vector meson. The one π, ρ, η, ω, K, K* exchange potentials are investigated separately. The number of arbitrary coupling constants is reduced by application of unitary symmetry. The conclusions are compared to those of previous works. (auth)

32550 METHODS FOR DETERMINING THE SPIN AND PARITY OF THE B PARTICLE. Ch. Zemach (Univ. of California, Berkeley). Nuovo Cimento (10), 32: 1605-12 (June 16, 1964).

Experimental tests for the spin and parity of the B particle (π-N resonance with I = 1, G = +1 at 1.2 Bev.) are derived from angular correlations of particles associated with production and decay of the B. (auth)

32551 ASSIGNMENTS OF THE $d_{\frac{3}{2}}$ OCTET. A. W. Martin (Argonne National Lab., Ill.). Nuovo Cimento (10), 32: 1645-52(June 16, 1964).

It is argued that the 1520-Mev Y_1^* should not be assigned to the $d_{\frac{3}{2}}$ octet in the unitary symmetry classification of strongly interacting states. Instead, this resonance is more likely to be a unitary singlet. The argument is based on two independent considerations—a reduced-width analysis of the $d_{\frac{3}{2}}$ resonances and an "effective threshold" model for the mass splittings between the members of the multiplet. As a consequence, if a $d_{\frac{3}{2}}$ octet exists, another Y_1^* resonance should be observed. Predictions are made concerning the position and partial widths of both this additional Y_1^* and the heretofore unobserved Ξ^* resonance belonging to the $d_{\frac{3}{2}}$ octet. (auth)

32552 ON THE ITERATION PROCEDURE IN THE PERATIZATION OF WEAK LEPTONIC INTERACTIONS. W. Kummer (CERN, Geneva). Nuovo Cimento (10), 32: 1653-64(June 16, 1964).

The field theory of weak interactions as formulated by Feinberg and Pais leads for the sum of uncrossed ladder graphs in weak leptonic scattering to the solution of two singular integral equations. A slight modification, which seems to be in the spirit of the whole approach, makes the full solution of one of them possible. In perturbation expansions in the coupling constant g^2, the limiting process for the invariant cut-off is tested, together with the Feinberg-Pais iteration procedure of solving the integral equation. Their result is reproduced up to second order in an unambiguous way. (auth)

32553 ASYMPTOTIC BEHAVIOUR FOR LARGE IMAGINARY VALUES OF ANGULAR MOMENTUM OF THE AMPLITUDES FOR THE SCATTERING OF A DIRAC PARTICLE ON A CENTRAL SCALAR POTENTIAL. F. Calogero (Università, Rome and Instituto Nazionale di Fisica Nucleare, Rome) and J. M. Charap. Nuovo Cimento (10), 32: 1665-84(June 16, 1964).

It is proved that the analytically-continued, partial-wave amplitudes for the scattering of a Dirac particle on a central scalar potential, which may be expressed as a superposition of Yukawa functions, vanishes as $|\mathrm{Im}\, J| \to \infty$. The potential has to be further restricted so that it vanishes at small distances and is weak. (auth)

32554 DOMINANCE OF EXCHANGE AMPLITUDES IN ELASTIC SCATTERING. D. Amati, L. L. Foldy, A. Stanghellini, and L. Van Hove (CERN, Geneva). Nuovo Cimento (10), 32: 1685-95(June 16, 1964).

For any internal symmetry group, the amplitude for the reaction A + B → C + D (s-channel) can be expressed in terms of amplitudes associated with irreducible representations of the group for the reaction A + $\bar{C}$ → $\bar{B}$ + D (t-channel) or the reaction A + $\bar{D}$ → C + $\bar{B}$ (u-channel). Physically these relations correspond to the expression of an s-channel amplitude in terms of amplitudes associated with the exchange of various systems between the interacting particles, these systems being identified by quantum numbers associated with irreducible representations of the group. Experimentally there appears to be evidence that for very high s-channel energies, one such amplitude in the t-channel gives the dominant contribution. Using these general crossing relations for the case of forward elastic scattering (A = C, B = D) and the optical theorem, it is shown that the only amplitude which can dominate in the t-channel for any group is that associated with the identity representation of the group (even if there is not invariance under the group) and that in the case of the isospin group, the only amplitude which can dominate in the u-channel is that corresponding to the maximum possible isospin. (auth)

32555 ON MASSIVE AND MASSLESS PHOTONS. N. Dombey (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 32: 1696-1706(June 16, 1964).

The vanishing of the longitudinal mode of a massive photon as the photon mass goes to zero in gauge-invariant electrodynamics is investigated. A distinction between two forms of gauge-invariant amplitudes is made in order to clarify this limit; conditions are then obtained, so that

the limiting process is smooth. From these conditions, results on the equality of particle charge which are usually derived by means of Ward's identity are obtained. (auth)

32556 VIRTUAL PARTICLES AND THE BARYON-BARYON SYSTEM. I. S. Gerstein (Univ. of Pennsylvania, Philadelphia). Nuovo Cimento (10), 32: 1707-14(June 16, 1964).

The $^1S_0$ virtual bound state of the N-N system is shown to belong to the 27-dimensional representation of the symmetry scheme based on SU(3) known as the eight-fold way. The other states of this multiplet are derived. Experimental evidence bearing on this state is discussed, and it is suggested that if the many complications of baryon number-2 states can be disentangled they can provide a fertile field for studying the validity of SU(3). (auth)

32557 A FORMULATION FOR THE TWO-NEUTRINO FIELDS. T. Toyoda (Università, Padua). Nuovo Cimento (10), 32: 1721-35(June 16, 1964).

A relation between the two-component theory of the neutrino and the Majorana theory is investigated to clarify the relation between Gatto's classification of lepton currents and Marshak's correspondence between baryons and leptons. An equivalence of these two formalisms as to lepton currents is demonstrated with some remarks on the role of Touschek's transformation. A new formulation for the two-neutrino fields is presented. It gives rather similar, but somewhat different results from Marshak. The correspondence between baryons and leptons including their transformation properties is also discussed. (auth)

32558 ON A GENERALIZED $|\Delta I| = \frac{1}{2}$ RULE IN NONLEPTONIC HYPERON DECAYS. N. P. Chang (Inst. for Advanced Study, Princeton, N. J.). Nuovo Cimento (10), 32: 1736-41(June 16, 1964).

A generalization of the $|\Delta I| = \frac{1}{2}$ rule in nonleptonic hyperon decays is studied under the unitary symmetry scheme. The weak Lagrangian is assumed to transform like $\lambda_6 \pm i\lambda_7$ under the SU(3) group. For the observable decays, this requirement leads to as many unknown constants in the Lagrangian as there are experimental parameters (asymmetries and lifetimes) presently available. Thus, until more data (s/p wave ratios) are known, a restricted version of the theory will have to be used. For a qualitative comparison, R symmetry is used to reduce the number of constants by half. (auth)

32559 A GENERALIZATION OF THE PHASE APPROACH TO SCATTERING THEORY, AND SOME NUMERICAL RESULTS. F. Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome) and D. G. Ravenhall. Nuovo Cimento (10), 32: 1755-71 (June 16, 1964).

A general treatment of the phase approach to scattering theory is presented. Equations are given for the difference in phase between the solutions of two general differential equations. The method is applied to potential scattering of Schrödinger and Dirac particles. By suitable choice of these differential equations, phase equations of the kind obtained previously are derived, together with some new ones. A remarkably simple result is obtained for the Dirac case in the extreme relativistic limit. A method is given for matching the solutions to known exterior functions. A numerical comparison of the accuracies of this approach and of the usual is given for two special cases. (auth)

32560 RECURSION FORMULA FOR THE INTERACTION ENERGY OF A CONFIGURATION OF n EQUIVALENT PARTICLES. D. Sperber (Illinois Inst. of Tech., Chicago). Nuovo Cimento (10), 32: 1772-8(June 16, 1964).

Explicit formulas for the coefficients of fractional percentage are developed. The interaction energy in an n-particle configuration is expressed as a linear combination of the interaction energy of the allowed terms in an (n−1)-particle configuration. (auth)

32561 A NEW POSSIBILITY IN THE KINEMATICAL ANALYSIS OF HIGH-ENERGY INTERACTIONS. E. M. Friedlaender and T. Visky (Inst. of Atomic Physics, Bucharest). Nuovo Cimento (10), 32: 1779-88(June 16, 1964).

If the kinetic energy of a single reaction product is plotted against the difference between its longitudinal momentum component and its kinetic energy, accumulation of figurative points along a straight line allows detection of two-body reactions. Recoil protons from two-prong 9-Bev p-p interactions in photographic emulsions, analyzed by this plot, yield evidence for meson (η) production in peripheral interactions. Various properties of this plot — physical as well as methodical — are discussed. (auth)

32562 ON THE POSSIBILITY OF DETERMINING THE PION-NUCLEON COUPLING CONSTANT FROM DEUTERON DATA. G. Bialkowski (Inst. of Theoretical Physics, Warsaw). Nuovo Cimento (10), 32: 1809-13(June 16, 1964).

Some calculations on the deuteron wave function by a previously developed model are discussed, with emphasis on the determination of the π-N coupling constant. (D.C.W.)

32563 A NOTE ON BARYON AND MESON RESONANCES. G. Costa (Università, Padua and Instituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 32: 1814-15(June 16, 1964).

The implications for resonance in various systems of a physical reality for quarks are briefly considered. (D.C.W.)

32564 NONLEPTONIC DECAY. Riazuddin (Univ. of Rochester, N. Y.), A. H. Zimerman, and Fayyazuddin. Nuovo Cimento (10), 32: 1819-22(June 16, 1964). (UR-875-32)

The nonleptonic decays are discussed in terms of a dynamical model based on the current-current interaction. The model provides a good explanation of the $K_1^0 \to \pi^+ - \pi^-$ decay rate and the s-wave amplitudes for nonleptonic hyperon decay. (D.C.W.)

32565 AN ARGUMENT AGAINST THE DOMINATION OF HIGH-ENERGY SCATTERING BY GRIBOV-POMERANCHUK FIXED SINGULARITIES. E. J. Squires (Univ. of Edinburgh). Nuovo Cimento (10), 32: 1823-4(June 16, 1964).

It was previously suggested that a Gribov-Pomeranchuk (fixed) singularity at J = 1 might dominate high-energy processes. It is shown, however, that unitarity forbids the occurrence of a Gribov-Pomeranchuk singularity at J = 1. (D.C.W.)

32566 RANGE-ENERGY RELATION FOR ULTRA-RELATIVISTIC MUONS. C. Castagnoli, A. De Marco, and R. Scrimaglio (Università, Turin). Nuovo Cimento (10), 33: 722-7(Aug. 1, 1964).

A range-energy relation for ultrarelativistic muons is calculated extending the calculation up to 10^4 Bev; using the Murota-Ueda-Tanaka theory for the pair production energy loss; utilizing for the nuclear energy loss, direct measurements on the σ_γ for star photoproduction; and using both the Weizsäcker-Williams and Kessler-Kessler theories for the spectrum of virtual photons. (auth)

32567 CONSEQUENCES OF U-SPIN FOR SEVERAL HIGHER SYMMETRIES. H. Harari (Israel Atomic Energy Commission, Yavne). Nuovo Cimento (10), 33: 752-62 (Aug. 1, 1964). (IA-909)

The U-spin is defined for the higher-symmetry models based on the G_2 and C_2 algebras. Some relations concerning the masses and electromagnetic properties of the particles are derived and compared with the experimental situation. The G_2 model is found to be in contradiction with experiment especially for electromagnetic processes. A conservation law for an additional spin, the I*-spin, is shown to be a consequence of both C_2 and G_2 symmetries. For C_2, this rule forbids at least one process which occurs in nature. (auth)

32568 GENERALIZATION OF THE RECIPROCAL BOOTSTRAP MECHANISM BETWEEN NUCLEON AND (3,3) π-N ISOBAR TO THE SU(3) OCTET SYMMETRY MODEL. Virendra Singh (Inst. for Advanced Study, Princeton, N. J.). Nuovo Cimento (10), 33: 763-8(Aug. 1, 1964).

The existence of a reciprocal bootstrap between baryon resonance decuplet with $J = {}^3/_2{}^+$ and baryon octet with $J = {}^1/_2{}^+$ is investigated in the exact SU(3) symmetry scheme. It is shown that the self-consistency equations are satisfied approximately if the parameter α, related to the d to f coupling ratio, lies in the range $0.5 \lesssim \alpha \lesssim 0.8$. (auth)

32569 EXACT SOLUTIONS OF ONE-DIMENSIONAL SCATTERING PROBLEMS. P. J. Brockwell and J. E. Moyal (Australian National Univ., Canberra). Nuovo Cimento (10), 33: 776-96(Aug. 1, 1964).

A one-dimensional model for particle scattering, which was applied by Fermi to neutron transport theory, is examined using the theory of discontinuous Markov processes. The process is characterized by the transition probabilities $P_{ik}(S/\omega; s)$ that a transition from a state ω to a state belonging to the set S occurs in path length accompanied by collisions with reversals and collisions without reversals. Assuming constant mean free path, the behavior of the particle, the state of which is specified by a position co-ordinate, a direction of motion and an absolute velocity, is determined completely and explicitly under a variety of boundary conditions. (auth)

32570 LOCALIZATION OF REGGE POLES IN POTENTIAL SCATTERING. D. Bessis (CEN, Saclay, France). Nuovo Cimento (10), 33: 797-808(Aug. 1, 1964).

It is shown that for potentials V(z) holomorphic in the right half-plane, bounded by $C|z|^{-1-\alpha}[0 < \alpha < 1]$, the Regge poles for $\mathrm{Re}\,\nu > 0$ and $-(\pi/2 - \mathrm{Arg}\,\nu) < \mathrm{Arg}\,k < +\pi/2$ are confined to simple and small domains. If V(z) is bounded by $C|z|^{-1-\alpha}\exp[-\mu\,\mathrm{Re}\,z]$, then even for $k \to +0$ the Regge poles remain confined in a domain which is bounded to the right and which is asymptotic to the imaginary axis in the ν plane. (auth)

32571 A MEASURE OF THE POLARIZATION OF HIGH-ENERGY $\bar{p}$ BEAM FROM ANGULAR CORRELATION IN REACTION $\bar{p}p \to YY$. G. Cohen-Tannoudji and A. M. L. Messiah (Service de Physique Théorique, Saclay, France). Nuovo Cimento (10), 33: 853-64(Aug. 1, 1964).

A method is proposed for determining the polarization of an antiproton beam to within the sign of its transverse component by angular correlation measurements on the decay of hyperon pairs produced in proton pair annihilation. The transition matrix of the annihilation process can also be determined to within a similar ambiguity in sign. (D.C.W.)

32572 A NOTE ON THE SIGNATURES OF THE DOMINANT REGGE TRAJECTORIES. Yan-chok Leung (Univ. of Colorado, Boulder). Nuovo Cimento (10), 33: 865-72 (Aug. 1, 1964).

By the requirements of the unitarity condition and the positive definiteness of the imaginary parts of the forward amplitudes, it was shown that the dominant Regge trajectories, it was shown that the dominant Regge trajectories of amplitudes that contribute to forward scattering passing through integer values of angular momenta in the interval $0 \leq t < 4\mu^2$, where t is the square of the momentum transfer and $4\mu^2$ is the square of the mass of the lowest intermediate state in the t-channel, must have definite signatures. This result is derived for amplitudes satisfying the Mandelstam representation. (auth)

32573 SOME CONSEQUENCES OF A REFLECTION PROPERTY IN THE COMPLEX λ-PLANE. J. E. Bowcock and A. P. Contogouris (Center for Advanced Studies in Physics and Nuclear Research Center "Democritus" Agia Paraskevi, Athens). Nuovo Cimento (10), 33: 873-82 (Aug. 1, 1964).

An s-matrix theory satisfying unitarity and the reflection property $S(-\lambda) = S(\lambda)\exp[-2i\pi\lambda]$ in the complex $\lambda = l + {}^1/_2$ plane is examined and the possibility of establishing analyticity and the asymptotic behavior of the scattering amplitude in $\cos\theta$ is discussed. If meromorphy of $S(\lambda)$ is added, it is concluded that a useful theory is possible only under special conditions on the behavior of S for $|\lambda| \to \infty$ and on the asymptotic distribution of the Regge poles; but then, the background term in the Sommerfeld-Watson transform disappears. The special conditions are shown to be due to the existence of an essential singularity at $\lambda = -i\infty$. In the presence of appropriate branch cuts, this last singularity appears only on the one side of the relevant cut. As a result, the Sommerfeld-Watson transform can be proved and the double spectral function of the Mandelstam representation can be explicitly determined in terms of the λ-plane singularities. (auth)

32574 SOME RIGOROUS INEQUALITIES SATISFIED BY DOUBLE-SPECTRAL FUNCTIONS. G. Mahoux and A. Martin (CERN, Geneva). Nuovo Cimento (10), 33: 883-94(Aug. 1, 1964).

Combining the elastic unitarity condition in the elastic strips of the $\pi\pi$ scattering amplitude and the positiveness of the partial-wave projections of the absorptive parts in the crossed channels, some rigorous inequalities on the spectral functions are derived. Some applications are considered. (auth)

32575 INELASTICITY EFFECTS ON THE LOW ENERGY PION-NUCLEON SCATTERING PHASE SHIFTS. F. Ferrari (Università, Bari, Italy and Instituto Nazionale di Fisica Nucleare, Bari, Italy), L. Nitti, F. Paccanoni, and M. Pusterla. Nuovo Cimento (10), 33: 895-905(Aug. 1, 1964).

An effective range formula that includes, in a phenomenological way, the inelastic contributions is derived for partial-wave amplitudes of the elastic scattering processes. The method is applied to the low-energy π-N scattering. It is found that a three parameter formula reproduces quantitatively the (3,3) resonance. (auth)

32576 ON THE PRODUCTION OF VECTOR MESONS AND ISOBARS IN THE PERIPHERAL MODEL. J. D. Jackson and H. Pilkuhn (CERN, Geneva). Nuovo Cimento (10), 33: 906-38(Aug. 1, 1964).

Two-body reactions involving the production of vector

mesons and/or baryonic resonances in pseudoscalar meson-nucleon collisions are considered within the framework of the peripheral model. General results are obtained for the production momentum transfer distributions and resonance decay correlations on the assumption of pseudoscalar- and vector-meson exchange. Drastic form factors are needed to bring the cross sections of the one-meson-exchange model into agreement with experiment, independent of the type of exchange. A detailed comparison between the theory and experiment is made for the K^+-p interactions ($K^-\Lambda \to K^*\Lambda$, $K^-\Lambda \to K\Lambda^*$, and $K^-\Lambda \to K^*\Lambda^*$) at 1.96 and 3.0 Bev/c. (auth)

32577 PHASE-SHIFT EQUATIONS FOR MANY-CHANNEL PROBLEMS. Ch. Zemach (Univ. of California, Berkeley). Nuovo Cimento (10), 33: 939-17(Aug. 1, 1964).

First-order differential equations for phase shifts are obtained for the many-channel case as a generalization of Calogero's results for ordinary potential scattering. (auth)

32578 INTERMEDIATE BOSONS AND UNITARY SYMMETRY. B. d'Espagnat and Y. Villachon (Faculté des Sciences, Paris). Nuovo Cimento (10), 33: 948-64(Aug. 1, 1964).

The consequences of a hypothesis concerning the interactions of the intermediate bosons w are investigated. The hypothesis is that the fundamental nonleptonic interaction of the w's belongs to the fundamental representations of the group U_3 of unitary symmetry. It is recalled that the phenomenological rules $\Delta S \neq 2$, $|\Delta I| \leq 1$ follow from this assumption, as well as the invariance of the nonleptonic weak interaction under the transformations of a SU_2 subgroup of U_3 and a few other predictions. Three models are possible, according to whether the w's belong to "3," "6," or "15." The first two are investigated in detail. Both are shown to be compatible with present experimental knowledge; both have distinctive features which could eventually be tested. The second allows for some $\Delta S = -\Delta Q$ admixture and for a tentative interpretation of the ratio between the phenomenological vector β and μ decay coupling constants. (auth)

32579 ON THE DETERMINATION OF THE MULTIPOLES IN PION PHOTO-PRODUCTION BY POLARIZED PHOTONS. H. A. Rashid (Technische Hochschule, Karlsruhe, Ger.). Nuovo Cimento (10), 33: 965-71(Aug. 1, 1964).

Relations for analysis of photoproduction experiments with polarized photons in the region of higher resonances where multipole states dominate are presented. The differential cross sections for polarized photons are given, assuming the dominance of various multipoles. Relations for the polarization of the recoil protons are also included. (D.C.W.)

32580 THE INFLUENCE OF LEADING PARTICLES ON DIFFRACTION SCATTERING AT VERY-HIGH-ENERGY. A. Bialas (CERN, Geneva). Nuovo Cimento (10), 33: 972-81(Aug. 1, 1964).

The effect of leading particles (nucleons or nucleon isobars) on diffraction scattering of strongly interacting particles at very high energy is investigated in the framework of the model of uncorrelated jets proposed by Van Hove. The conditions under which the correction from leading particles becomes important are examined in some detail. It appears that its behavior depends mainly on the behavior of the transverse momentum distribution of the leading particles as compared with the transverse momentum distribution of pions. (auth)

32581 PROTON-PROTON SCATTERING AT HIGH ENERGY AND SHRINKAGE OF THE DIFFRACTION PEAK. S. Minami, T. A. Moss, and G. A. Armoudian (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 33: 982-7 (Aug. 1, 1964).

The shrinkage of the diffraction peak in p-p elastic scattering at high energy is investigated. Some data for proton momenta of 10.8 and 19.6 Bev/c are analyzed. (D.C.W.)

32582 ANALYTICITY OF COMPOUND-PARTICLE SCATTERING AMPLITUDES. J. T. Cushing (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 33: 988-9(Aug. 1, 1964).

Similarity in the analytic properties of the elastic scattering amplitudes for scattering of an elementary particle by another elementary particle and by a compound particle is noted and discussed. (D.C.W.)

32583 WEAK NON-LEPTONIC INTERACTIONS IN THE QUARK MODEL. M. Ademollo and R. Gatto (Università, Florence and CNEN, Frascati, Italy). Phys. Letters, 10: 339-40(June 15, 1964).

A method of generating weak non-leptonic interactions from weak perturbations of the free quark Lagrangian is presented. The resulting weak non-leptonic Lagrangian behaves as an octet with $\Delta T = \frac{1}{2}$ under SU_3. (L.B.S.)

32584 ON THE PRODUCTION MECHANISM OF THE $\bar{K}^*$-RESONANCE. E. S. Gelsema, J. C. Kluyver, A. G. Tenner, and G. F. Wolters (Zeeman Laboratorium, Amsterdam). Phys. Letters, 10: 341-4(June 15, 1964).

An analysis of the decay of the $\bar{K}^*$ from a study of 392 events of the type, $K^- + p \to \bar{K}^0 + \pi^- + p$, is reported. A fit of a Breit-Wigner curve to the effective $\bar{K}^0\pi^-$ mass distribution yielded a value of 891 ± 3 Mev for $M(\bar{K}^*)$ and 50 ± 13 Mev for $\Gamma(\bar{K}^*)$. (L.B.S.)

32585 CONSEQUENCES OF THE N-N CHARGE-EXCHANGE PEAK FOR ELASTIC SCATTERING. R. J. N. Phillips (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 10: 344-6(June 15, 1964).

Possibilities for the charge-exchange mechanism — the dependence of i-spin and ordinary spin, and whether the scattering amplitude is mainly real or imaginary — are discussed systematically. Consequences for elastic scattering are described and examples are given. (L.B.S.)

32586 DECAY OF BARYON RESONANCES IN THE UNITARY SYMMETRY MODEL. M. Konuma (Scola Normale Superiore, Pisa, Italy) and Y. Tomozawa. Phys. Letters, 10: 347-8(June 15, 1964).

A relation between decay widths of the decuplet baryon resonances in the unitary symmetry model, using a symmetry breaking interaction as a perturbation, is presented. (L.B.S.)

32587 ANGULAR DISTRIBUTION OF CHARGE EXCHANGE OF π-NUCLEON BETWEEN 600 AND 900 Mev. A. Muller (CEN, Saclay, France), E. Pauli, R. Barloutaud, J. Meyer, M. Beneventano, G. Gialanella, and L. Paoluzi. Phys. Letters, 10: 349-51(June 15, 1964). (In French)

The reaction $\pi^+ + d \to \pi^0 + p + p$ was studied at pion energies of 600, 650, 750, 800, and 850 Mev. Effective differential cross sections were obtained by fitting measured angular distribution points with series expansions of $d\sigma/d\Omega = \Sigma\, a_n \cos^n\theta^*$ for the reaction $\pi^+ + n \to \pi^0 + p$, considering the less energetic scattered proton as a spectator. Measured total cross sections are compared with other experimental values. (M.J.T.)

32588 ON THE HIGH-ENERGY BEHAVIOR OF PARTIAL WAVE AMPLITUDES. P. Olesen (Institut for Teoretisk Fysik, Copenhagen). Phys. Letters, 10: 352-4 (June 15, 1964).

The main assumptions, unitary, analyticity, and diffraction, in an approach to the problem of the high-energy behavior of elastic amplitudes are given, together with a discussion of the results. (L.B.S.)

32589 ON THE COUPLING CONSTANTS OF MASSLESS PARTICLES. A. O. Barut (Univ. of Colorado, Boulder). Phys. Letters, 10: 356-7(June 15, 1964).

The restrictions imposed on the most general form of the form factors for massless particle coupling, which in the limit go over to the coupling constants, are given and the universality of the form factors is shown. Only invariance under the proper inhomogeneous Lorentz group is used. (L.B.S.)

32590 AMPLITUDE BOUNDS IN THE LADDER GRAPH APPROXIMATION. George Tiktopoulos and S. B. Treiman (Princeton Univ., N. J.). Phys. Rev., 135: B711-15 (Aug. 10, 1964).

Forward scattering in the ladder approximation for a trilinear scalar interaction is considered. The corresponding Bethe-Salpeter integral equation for the absorptive part of the amplitude is of the Volterra type; and the kernel and inhomogeneous term are both positive. These special features are used in order to set upper bounds on the absorptive amplitude for arbitrary values of the coupling constant g. Two different techniques are described. For large scattering energies the bounds obtained imply corresponding bounds on the value of the leading Regge pole $\alpha(0)$. In the limit of weak coupling the upper bound on $\alpha(0)$ is linear in g^2 and in fact coincides exactly with the known weak-coupling result. In the limit of strong coupling the upper bound varies as the square root of g^2. The correctness of this feature is discussed on the analogy with the Schrödinger problem of binding in a potential field. (auth)

32591 APPROXIMATION TECHNIQUES IN THREE-BODY SCATTERING THEORY. Leonard Rosenberg (New York Univ., New York). Phys. Rev., 135: B715-23 (Aug. 10, 1964).

With the aid of some operator algebra the Lippmann-Schwinger integral equations for three-body transition amplitudes are recast in a form that involves two-body transition operators rather than two-body potentials. These equations, which are uncoupled and apply to all channels, are ideally suited to be the basis for approximation schemes, of the impulse approximation type, which have the distinctive feature of preserving unitarity. Two such approximations are described. With either of these as the leading term, a method of successive approximations is developed which yields an expansion for the exact amplitude whose convergence properties are expected to be considerably improved over the usual Born and multiple-scattering expansions. At high energies and low momentum transfers a unitary version of the strip approximation is obtained. Here the integral equation is quite tractable and represents the nondispersion-theoretic analog of multiparticle N/D techniques which were applied recently to N-N and π-N reactions. (auth)

32592 INELASTIC EFFECTS IN NUCLEON-NUCLEON SCATTERING. Yan-chok Leung (Massachusetts Inst. of Tech., Cambridge and Univ. of Colorado, Boulder). Phys. Rev., 135: B732-45(Aug. 10, 1964).

The possibility that the elastic scattering amplitude may be substantially enhanced due to the opening of a strong inelastic channel as the elastic and inelastic channels are coupled through the unitarity condition is examined. Some recent experimental data on proton-proton scattering suggested rather convincingly such a phenomenon. The theoretical investigation of this feature is carried out by means of the current method of dispersion relations. The dynamical inputs of the scattering amplitudes are derived from the perturbation diagrams of the Feynman theory using only the one-pion-exchange diagrams. A multichannel unitarity condition is used by retaining the three-particle intermediate states. This provides a coupling between the elastic and the production amplitudes. Finally, the problem is solved in terms of the N/D method. The results obtained demonstrate a maximum in the elastic scattering amplitude, which seems to explain the observed phenomenon. (auth)

32593 NEW SYMMETRY GROUP FOR ELEMENTARY PARTICLES. I. GENERALIZATION OF LORENTZ GROUP VIA ELECTRODYNAMICS. Behram Kurşunoğlu (Univ. of Miami, Coral Gables, Fla.). Phys. Rev., 135: B761-8 (Aug. 10, 1964).

By using the definition of the photon angular momentum a connection between the Lorentz group and the unitary symmetry group of the strong interaction is established. The new group (to be called ILU_4) is a twenty-parameter group containing SU_3 and the inhomogeneous Lorentz group as its subgroups. The space-time and internal symmetries of dynamical systems may be described by a single symmetry group. The new symmetry group imparts a unitary content to every Lorentz frame of reference. (auth)

32594 ELECTRIC DIPOLE MOMENT OF A NUCLEON. N. T. Meister and T. K. Radha (Stanford Univ., Calif.). Phys. Rev., 135: B769-72(Aug. 10, 1964).

A violation of time-reversal invariance of any of the elementary particle interactions would imply the existence of a static electric-dipole moment for all these particles. A theoretical estimate of the electric-dipole moment (μ_e) of a bare nucleon is made, assuming the existence of an intermediate vector boson (W) and a small violation of T invariance for the weak interactions. With the existing experimental upper limit for T violation from polarized neutron decay, it is found that $\mu_e \lesssim e/m_N \times 10^{-7}$. Since a value for μ_e somewhat smaller than this upper limit seems to be experimentally observable, such an experiment would provide a good test for T invariance as well as for the existence of W mesons. (auth)

32595 MASS FORMULAS AND MASS INEQUALITIES FOR REDUCIBLE UNITARY MULTIPLETS. S. Coleman, S. L. Glashow, and D. J. Kleitman (Harvard Univ., Cambridge, Mass.). Phys. Rev., 135: B779-82(Aug. 10, 1964).

For irreducible unitary multiplets of elementary particles, the Gell-Mann-Okubo mass formula is equivalent to the assertion that the effective masses transform under SU(3) like a superposition of a singlet and the neutral member of an octet. The implications of this assertion for reducible unitary multiplets are considered. Weaker mass formulas, which allow for the mixing between different irreducible components, are found. It is also found that certain inequalities must be satisfied. Specific examples are described. (auth)

32596 SU(3) AND WEAK INTERACTIONS. V. Gupta (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 135: B783-8(Aug. 10, 1964).

Assuming the existence of two more neutrinos ν'_e and ν'_μ, it is suggested that the leptons fit in SU(3) triplets and that the lepton-lepton and lepton-baryon interactions are SU(3) symmetric. Possible existence of a SU(2) symmetry for these interactions is also considered. For either symmetry four neutrinos seem essential, and it is pointed out

how experiment can test the existence of the two new neutrinos. (auth)

32597 CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY $K \rightarrow \mu + \nu + e^+ + e^-$. Edward S. Ginsberg (Stanford Univ., Calif.). Phys. Rev., 135: B792-5 (Aug. 10, 1964).

The effect of an intermediate vector boson, with arbitrary anomalous magnetic and quadrupole moments, was investigated for the decay $K \rightarrow \mu + \nu + e^+ + e^-$. The presence of the boson can have a striking effect on the orientation of the plane of the Dalitz pair relative to the decay plane. This effect is greatest in a kinematic region where the Dalitz pair emerges at a large backward angle with respect to energetic muons. As in the radiative decay $K \rightarrow \mu + \nu + \gamma$, there is an enhancement in the differential transition probability in this region. Sample distributions in the momentum and energy separation of the Dalitz pair are given. (auth)

32598 PHENOMENOLOGICAL ANALYSIS OF REACTIONS SUCH AS $K^- + p \rightarrow \Lambda + \omega$. N. Byers (Univ. of California, Los Angeles) and C. N. Yang. Phys. Rev., 135: B796-800(Aug. 10, 1964).

The angular correlation function describing the decay products of Λ and ω in the reaction $K^- + p \rightarrow \Lambda + \omega$ is analyzed and expressed in terms of production matrix elements. It is shown that, with a unpolarized target, aside from two phase factors all production matrix elements can be determined from angular correlations. With a polarized target, the production matrix elements may be completely determined up to an over-all phase factor. In addition, with a polarized target the $K-\Lambda$ relative parity may be directly measured. (auth)

32599 PROOF OF A CONJECTURE OF S. WEINBERG. W. Hunziker (Princeton Univ., N. J.). Phys. Rev., 135: B800-3(Aug. 10, 1964).

A proof is given of Weinberg's conjecture that the irreducible N-particle kernel is of Hilbert-Schmidt type if the potentials, which describe the pair interactions, are square integrable. (auth)

32600 ONE-NUCLEON EXCHANGE IN PION-NUCLEON SCATTERING. Arthur W. Martin and Jack L. Uretsky (Argonne National Lab., Ill.). Phys. Rev., 135: B803-9 (Aug. 10, 1964).

The partial-wave amplitudes for pion-nucleon scattering in the approximation where the driving force comes from single-nucleon exchange were studied. The assumption is made that the amplitudes satisfy dispersion relations, but it is found that this is not enough to define a unique problem. Some restrictions upon the choice of amplitude to be inserted in the dispersion relations are found, but some ambiguities remain. Settling these in a reasonable way leads to the conclusion that the one-nucleon-exchange force is too strong. (auth)

32601 NEUTRON FORM FACTORS FROM INELASTIC ELECTRON-DEUTERON SCATTERING. C. W. Akerlof, K. Berkelman, G. Rouse, and M. Tigner (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 135: B810-15(Aug. 10, 1964).

The differential cross section for quasielastic scattering of electrons from neutrons initially bound in deuterium was measured at 90 and 120° laboratory angle for values of the four-momentum transfer squared equal to 11, 15, 20, 25, and 35 F^{-2}. The yield of momentum analyzed scattered electrons was measured using CD_2, CH_2, and C targets. The Durand theory for the effects of deuteron binding is used to extract experimental values for the ratio of the electron-neutron and electron-proton differential cross sections. Over most of the range of the experiment σ_n/σ_p between 0.3 and 0.5. The neutron form factors obtained are consistent with previous measurements at lower momentum transfer. $|G_{En}|$ remains less than 0.3 and $|G_{Mn}|$ continues its decrease toward zero with increasing momentum transfer ($|G_{Mn}| < 0.2$ at $q^2 = 35$ F^{-2}). (auth)

32602 $K^+\Lambda$ PHOTOPRODUCTION FROM HYDROGEN AT 1200 Mev. Charles W. Peck (California Inst. of Tech., Pasadena). Phys. Rev., 135: B830-8(Aug. 10, 1964). (TID-20573)

Measurements of the angular distribution of the cross section for the photoproduction of the $K^+\Lambda$ system from hydrogen were made in the cm angular interval from 15 to 85° at a photon energy of 1200 Mev. The reaction was identified by detecting the K^+ mesons with a magnet spectrometer and a velocity selection system consisting of two Cherenkov counters. The angular distribution at this energy is very similar to that at lower energies in that it is peaked forward and is easily fit with a quadratic in $\cos\theta_{cm}$. Special emphasis was placed on the forward direction in an attempt to find evidence for the one-K-exchange pole. A Taylor-Moravcsik analysis of the data is presented, but the results are inconclusive. (auth)

32603 DYNAMICAL SYMMETRY GROUP BASED ON DIRAC EQUATION AND ITS GENERALIZATION TO ELEMENTARY PARTICLES. A. O. Barut (Univ. of Colorado, Boulder). Phys. Rev., 135: B839-42(Aug. 10, 1964).

The dynamical or exact symmetry group of the nonrelativistic Kepler problem (a symmetry group in four dimensions) is generalized to the Dirac equation and further to elementary particles. The former is a ten-parameter group of rank two isomorphic to a group in five dimensions, the latter a 16-parameter group of rank four isomorphic to a group in six dimensions. Both groups contain the real Lorentz group and couple the space-time quantum numbers with the internal quantum numbers. The 16-parameter group has a 15-parameter simple subgroup and contains two three-dimensional rotation groups, one for ordinary spin and one for isotopic spin. The concept of inhomogeneous dynamical group is introduced. The inhomogeneous group contains two new additive quantum numbers to describe the hypercharge and the baryon number and leads to a mass spectrum. The third component of isospin and the new additive quantum numbers commute with all the six generators of the Lorentz group. A further generalization leads to a group where all three isospin generators commute with the Lorentz group. (auth)

32604 STUDY OF A SELF-CONSISTENT CALCULATION OF THE Ω^- AS A $\overline{K}\Xi$ BOUND STATE. G. L. Kane (Johns Hopkins Univ., Baltimore). Phys. Rev., 135: B843-9 (Aug. 10, 1964).

The $\overline{K}\Xi\Omega^-$ system was studied in a self-consistent manner, both to see if the Ω^- can be interpreted as a $T = 0\overline{K}\Xi$ bound state, and to study such calculations in a situation where only one two-particle channel need be considered. The method of Singh and Udgaonkar, and Patr is followed, using for dynamical singularities both a short cut due to single particle exchange and a self-consistently determined distant left cut. Only the $J = {}^3/_2{}^+$ partial wave is considered. The main result is a curve relating the strength (called g^2) of the single-particle exchange-forces to the position of a bound or a resonant state. The binding energy is found to increase with increasing g^2 until the mass of the bound state is about 1680 Mev. Further increases in g^2 have

essentially no effect. On the other hand, it is found that resonant states exist for $g^2 \leq 0$, so that the calculation as it stands allows resonances with repulsive single-particle exchange forces. The calculation in its present form is consistent with bound or resonant states for both T = 0 and T = 1, the former at about 1680 Mev for reasonable values of g^2. It is shown that the results are essentially independent of subtraction point, matching points, and similar parameters. The dependence of the results on the short cut and on the distant cut is discussed. The manner in which calculations using only the Born approximation for the dynamical singularities can give the same results as indicated. The possible existence of two zeros in ReD, noticed by Abers and Zachariasen, is briefly discussed. A second zero does appear in the present calculation at about 4 Bev, but results from the phase shift decreasing through $\frac{1}{2}\pi$ rather than from the Abers-Zachariasen mechanism. Thus, no alternative solution is found in the present calculation. (auth)

32605 QUANTUM MECHANICS OF THE $(p\text{-}\mu\text{-}p)^+$ MOLECULAR ION. W. Roy Wessel (Univ. of Michigan, Ann Arbor) and Paul Phillipson. Phys. Rev. Letters, 13: 23-5(July 6, 1964).

Wave functions and energies of the $(p\text{-}\mu\text{-}p)^+$ molecular ion were computed, using the exact Hamiltonian of $(p\text{-}\mu\text{-}p)^+$; the Born-Oppenheimer approximation was not invoked, although the spin of the particles was neglected. Ground (para) state values obtained are 254.3 ev for the binding energy and 0.00846 Å for the expectation value of the interpretation separation. Ortho state calculations were approximate, neglecting the term coupling the three equations defining the ortho wave function; a binding energy of 102.2 ev and an expectation value of 0.0104 Å were obtained. The μ-p overlap was also calculated for both states. (M.J.T.)

32606 TEST OF THE VALIDITY OF $\Delta S = \Delta Q$ RULE IN K^0 DECAY. L. Kirsch (Rutgers Univ., New Brunswick, N. J.), R. J. Plano, J. Steinberger, and P. Franzini. Phys. Rev. Letters, 13: 35-7(July 6, 1964).

An experiment was conducted to check with greater sensitivity if, in the equation for the time distribution of leptonic decays of a beam of incoherently mixed K^0 and $\overline{K}^0$ mesons, the parameter $\alpha \neq 1$, proving that the $\Delta S = -\Delta Q$ amplitudes are nonvanishing. The K^0's are produced in the annihilation of antiprotons in hydrogen. Of 5058 measurements of V's within a 15-cm circle of stopped antiprotons, 45 events were retained and analyzed. Decay-time distributions are plotted. The parameter α was found to be $0.85^{+1.8}_{-0.35}$, in agreement with $\Delta S = \Delta Q$. (M.J.T.)

32607 EMPIRICAL SYSTEMATICS OF THE STRONGLY INTERACTING PARTICLES. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 37-40(July 6, 1964). (BNL-7941)

A set of mass relations involving the mesonic resonances and the baryon isobars is pointed out. Expressions of the form $m = pm_\pi + q\kappa$, where $m_\pi = \frac{1}{2}(m_{\pi^\pm} + m_{\pi^0}) = 137.3$ Mev and $\kappa = \frac{1}{4}m_N = \frac{1}{4} \cdot \frac{1}{2}(m_p + m_n) = 234.7$ Mev, are obtained for some meson resonances and baryon states. Assignments of (p,q) are listed, and derived experimental masses are compared. Strongly interacting particles are plotted in terms of p and q. Other mass relations of this type were also obtained. It was also found that, for several pairs of strongly interacting particles (a,b), $m_b = \lambda m_a$, where λ is a simple fraction. (M.J.T.)

32608 EMPIRICAL PION-NUCLEON SPECTROSCOPY. Bernard Thevenet (Brookhaven National Lab., Upton, N. Y.) and Janos Zsembery. Phys. Rev. Letters, 13: 40-2 (July 6, 1964). (BNL-8041)

Simple connections existing between presently known π-N resonances, i. e., all the maxima of the $\pi^\pm$ p cross sections, are shown. $T = \frac{1}{2}$ resonances are considered as excited levels of the nucleon and $T = \frac{3}{2}$ resonances as excited levels of the isobar Δ. Thus the isobar plays a role analogous to that of the nucleon. The nucleon, the isobar, and seven known resonances are arranged in columns ($\lambda = 1, 2, 3, \ldots$) by increasing mass; it is found that $\lambda = J - T + 1$. Several other resonances, with their masses and angular momenta, are thus predicted. (M.J.T.)

32609 APPARENT REGULARITY IN THE MASSES OF THE MESONS. Laurie M. Brown (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 13: 42-4(July 6, 1964).

A set of masses, calculated from the formula $m^2 = a^2[2n + \frac{1}{4}Y^2 - I(I+1)]$, where a = 385 Mev, n is an integer, and the hypercharge and isospin (Y,I) have the values they assume in an SU(3) meson octet, e.g., (0,0), $(\pm 1, \frac{1}{2})$, and (0,1), are arranged and compared with known meson masses. Discrepancies between the predictions and the known mesons are discussed. (M.J.T.)

32610 EFFECT OF ABSORPTIVE CHANNELS ON THE ONE-PARTICLE EXCHANGE MODEL. A. Dar (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Letters, 13: 91-4(July 20, 1964).

The agreement with experimental angular distributions obtained for many peripheral elementary particle reactions by using a simple model incorporating strong absorption of low partial waves into the one-particle exchange model is illustrated for three reactions, and a list of the reactions which have been treated by this model, with their corresponding radii, are presented. (L.B.S.)

32611 POLARIZATION OF THE MUON FROM $K^+_{\mu 3}$ DECAY. George Gidal (Univ. of California, Berkeley), Wilson M. Powell, Robert March, and Sergio Natali. Phys. Rev. Letters, 13: 95-8(July 20, 1964). (UCRL-11448)

A measurement of the ratio of the form factors, ξ, from the longitudinal polarization of the muon in $K_{\mu 3}$ decay is reported. The value, -0.15 ± 0.90, is shown to be in agreement with recent measurements. (L.B.S.)

32612 ENERGY SPECTRUM OF π^+ IN $K^+ \rightarrow \pi^+\pi^0\pi^0$ DECAY. George E. Kalmus (Univ. of California, Berkeley). Anne Kernan, Robert T. Pu, Wilson M. Powell, and Richard Dowd. Phys. Rev. Letters, 13: 99-101(July 20, 1964).

The kinetic-energy spectrum of the π^+ meson in τ' decay was studied from 10 to 53 Mev. The τ' decay mode was identified by the decay of $\pi^+ \rightarrow \mu^+ + \nu$ of the charged-pion secondary after it had come to rest; the π^+ energy was determined by range measurements. Results were consistent with the $\Delta = \frac{1}{2}$ rule, the linear-matrix element approximation, and the pion pole model for $K(\eta) \rightarrow 3\pi$ decays. (L.B.S.)

32613 EXPERIMENTAL STUDY OF THE DECAY MODE $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$. D. Cline and W. F. Fry (Univ. of Wisconsin, Madison), Phys. Rev. Letters, 13: 101-3 (July 20, 1964).

A search for the $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ decay mode in a scan of 16500 stopped K^+ yielded 18 events. The charged-pion kinetic-energy spectrum based on these events is shown, along with the theoretical prediction of Cabibbo and Gatto for both constructive and destructive interference, and the spectrum expected for pure inner bremsstrahlung. The estimated branching ratio with respect to all K^+ decays for the kinetic-energy interval 55-80 Mev was found to be $2.2 \pm 0.7 \times 10^{-4}$, which is consistent with 1.6×10^{-4} predicted for pure inner bremsstrahlung. (L.B.S.)

32614 STRUCTURE IN FORWARD-DIRECTION $\pi^- - p$ CHARGE-EXCHANGE SCATTERING IN THE 3 Gev/c REGION. M. A. Wahlig, I. Mannelli, L. Sodickson, O. Fackler, C. Ward, T. Kan, and E. Shibata (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 13: 103-5(July 20, 1964). (TID-20578)

Evidence of the strong energy dependence of the forward-direction elastic charge-exchange scattering for the $\pi^- + p \rightarrow \pi^0 + n$ reaction in the lower part of the energy range, $p_{\pi^-} = 2.4$ to 18 Bev/c, is reported. Experimental details are presented. The cross section versus laboratory momentum shows a strong resonance structure, which is interpreted as an $I = \frac{1}{2}$ resonance at approximately 3.1 Bev/c, or as two $I = \frac{3}{2}$ resonances at approximately 2.6 and 3.5 Bev/c. (L.B.S.)

32615 SOME REMARKS ON THE NINTH PSEUDOSCALAR MESON. C. Becchi and G. Morpurgo (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Phys. Rev. Letters, 13: 110-12(July 20, 1964).

It is pointed out that the experimental evidence for the absence of a ninth pseudoscalar meson is not very strong, and that if the present explanation of the vector nonet is correct, a ninth pseudoscalar might be conjectured to exist with properties similar to those of the φ meson. (L.B.S.)

32616 POLARIZED ELECTRONS AND POSITRONS BY TAGGING TECHNIQUE. Haakon Olsen and L. C. Maximon (National Bureau of Standards, Washington, D. C.). Phys. Rev. Letters, 13: 112-14(July 20, 1964).

The application of a coincidence technique to the pair-production process in order to create polarized high-energy electrons or positrons from unpolarized photons is described. The method utilizes the correlation between the electron, positron, and photon momentum and the electron or positron polarization. Curves for the longitudinal and transverse polarization of the electron—also for corresponding values for positron polarization—are calculated for arbitrary directions and energies for copper and lead. (L.B.S.)

32617 SELF-CONSISTENCY OF HIGHER SYMMETRY UNIVERSES. Donald E. Neville (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 118-22(July 20, 1964).

The strongest version of the bootstrap theory predicts that it should be possible to rule out all strong interaction symmetries other than the observed one, SU(2) ⊗ Y, where Y is hypercharge, by requiring all particles to generate themselves self-consistently. It is proved, however, that with the present knowledge of dynamics, a first-approximation SU(n) universe of the familiar type—0^- mesons and $\frac{1}{2}^+$ baryons—exists for every n. It is expected that, in the course of progress in the understanding of higher symmetry crossing matrices, the bootstrap requirement will rule out a large class of universes, even in first approximation. The similarity of the crossing matrices of low- and high-rank groups is emphasized. A difference is demonstrated in considering the I = 0 vacuum Regge trajectory. It is discussed whether the strong-interaction symmetry observed in nature should be described as a broken SU(3) or a broken SU(4) symmetry, by considering an additional hypercharge quantum number carried by particles existing at higher energies than have been studied. (M.J.T.)

32618 EVIDENCE FOR THE 2π DECAY OF THE K_2^0 MESON. J. H. Christenson, J. W. Cronin, V. L. Fitch, and R. Turlay (Princeton Univ., N. J.). Phys. Rev. Letters, 13: 138-40(July 27, 1964).

A search was made for the 2π decay of mesons (K_2^0) which were produced from a Be target bombarded by 30-Bev protons. Measurements indicate that the meson (K_2^0) decays to two mesons(π) with a branching ratio of $(2.0 \pm 0.4) \times 10^{-3}$. (C.E.S.)

32619 IMPLICATIONS OF A POSSIBLE $J^P = \frac{3}{2}^+$ OCTET. Elizabeth Johnson and R. F. Sawyer (Univ. of Wisconsin, Madison). Phys. Rev. Letters, 13: 141-3 (July 27, 1964).

Experimental evidence for the octet assignment of the $\frac{3}{2}^+$ Y_1^* resonance with a mass of 1660 Mev is discussed. (C.E.S.)

32620 COMMENTS ON HIGHER RESONANCE MODELS. C. Goebel (Univ. of Wisconsin, Madison). Phys. Rev. Letters, 13: 143-6(July 27, 1964).

Resonance models for meson-N and meson-N* interactions are discussed. Singularities near the physical region are discussed as a possible driving force in dynamical models. Static models are also considered. (C.E.S.)

32621 INELASTIC INTERACTIONS OF π^- MESONS WITH NUCLEONS AT 6.8 Gev. Tsu-tseng Wang, Shih-wei Wang, Shu-fen Wang, Tseing-ju Jeng, Chun-hsun Lo, Te-chiang Huang, and Pu-in Cheng. Sci. Sinica (Peking), 13: 897-918(June 1964). (In Russian)

Inelastic $\pi^- - N$ interactions (317) were studied in nuclear emulsion. It is shown that secondary charged particles in the incidence π-N center-of-inertia system are in agreement with published data. However, at large angles (>90°) the mean magnitude of the transverse momentum as a function of emission angle is not in agreement is available data. All distributions are explained in principle as peripheral collisions. For events with secondary protons the total energies of secondary ω particles (except protons) were calculated in their proper center-of-inertia system. The curve for ω at 1.5 Bev exceeds the limits of a curve based on the theory of peripheral collisions and one meson exchange. Factors influencing the distribution were analyzed. Calculations were made of the inelasticity coefficient for K_3 in a mirror system, and correlations were made in the theoretical curve. The Duller and Walker methods were used in the analysis of K_3 magnitudes according to target mass. (tr-auth)

32622 QUASI-MONOCHROMATIC AND POLARIZED HIGH-ENERGY γ QUANTA. F. R. Arutyunyan and V. A. Tumanyan. Usp. Fiz. Nauk, 83: 1-34(May 1964). (In Russian)

A review is given of various methods for obtaining quasichromatic, polarized, high energy γ quanta. Electron bremsstrahlung, the basic method for developing γ quanta, is inconvenient due to the difficulty in separating the bremsstrahlung spectra. Moreover, γ beams produced by electron bremsstrahlung in amorphous materials do not possess separate polarization. The formation of electron-positron pairs in crystals and light scattering on relativistic electrons are discussed as two most promising methods for the preparation of quasimonochromatic and polarized γ quanta. (R.V.J.)

32623 EQUATIONS FOR THE VERTEX PARTS AND BOUND STATES. M. A. Braun. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 5-13(1964). (In Russian)

The system of dispersion theoretic equations for the vertex parts π NN and NND with a nucleon off the mass shell is studied in the low energy region in the spinless particle model. The anomalous threshold is calculated

by analytic continuation in the mass variable. Under the assumption that the deuteron is a bound state of the nucleons, an equation is obtained for the determination of its mass. (auth)

32624 THE NEAR-THRESHOLD BEHAVIOR OF INELASTIC SCATTERING. T. V. Zhikhareva. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 21-5(1964). (In Russian)

The resonance effect and the behavior of s- and p-sections, the first inelastic reaction near the threshold of the second one is studied within the limits of the effective range theory. It is shown that for s-section σ_{12} the value of threshold anomaly is proportional to the sum of inelastic sections σ_{13} and σ_{23}. (auth)

32625 THE DISTORTION OF DEUTERONS IN ELASTIC n-d SCATTERING. H. Borik and S. Fluegge (Universität, Freiburg i. B.). Z. Physik, 180: 1-9(1964). (In German)

Neutrons scattered at deuterons will distort the deuteron wave function. This effect is of interest in the ^2S state where a step towards formation of an intermediary triton is possible. A distortion consisting of a spherically symmetrical contraction of the deuteron was considered. It can be shown that under reasonable assumptions the contraction does not go as far as to reduce the average nucleon distance to triton size, but that the effect on ^2S phase shifts is remarkable and leads to a better agreement with the results of the empirical phase shift analysis. Results were also obtained for the ^4S phase shifts. (auth)

32626 ASYMPTOTIC SCATTERING AMPLITUDE OF MESONS ON NUCLEONS. N. N. Meiman (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1502-4(Apr. 1964). (In Russian)

The elastic scattering amplitudes of the reaction $p + k \to p' + k'$ are considered. An asymptotic retarding amplitude $F_\infty^{ret}(\omega,t) = i\int d^4x\, e^{i\omega(x^0-ex)}\left\langle p'\left|\left[j\left(\frac{x}{2}\right)j\left(-\frac{x}{2}\right)\right]\right|p\right\rangle$, $x \gtrsim 0$, is introduced. A variable $\tau = [x^0 - ex]/\tau_2$ is substituted. It is required that the principle of causality and of the absense of long-range effects be fulfilled. The most general class of generalized functions satisfying this requirement has the form $\psi(\tau) = \sum_{\nu=0}^{\infty}\int_{-0,-1^\nu}^{\infty}\vartheta^{(\nu)}(\tau-\xi)\frac{d\sigma_\nu(\xi)}{\nu!}$, where $\sqrt[\nu]{s_\nu} \to 0$ as $\nu \to \infty$, $s_\nu = \int_0^\infty |d\sigma_\nu(\xi)|$. It follows that the result of the application of the generalized function $\psi(\tau)$ to the Cauchy nucleus $\frac{1}{2\pi i}\frac{1}{\zeta-\tau}$ is analytical in the ζ function, within the positive semiaxis:

$$U_4(\zeta) = \sum_{\nu=0}^{\infty}\frac{1}{2\pi i}\int_0^\infty \frac{d\sigma_\nu(\tau)}{(\zeta-\tau)^{\nu+1}}.$$

From the Cauchy formula for the function $\phi(\tau)$ from the basic space, it follows that $(\psi,\phi) = \int_{C_\phi} U_4(\zeta)\,\phi(\zeta)d\zeta$. The retarding asymptotic amplitude $F_\infty^{ret}(\omega,t)$ on any fixed $t \le 0$ is the Fourier transform of the generalized function $\psi(\tau,t)$. It follows that this transform is the analytical function of ω in the upper half plane Im $\omega > 0$, and increases more slowly than any exponent $e^{\epsilon|\omega|}$, $\epsilon > 0$. (M.J.T.)

32627 STUDY OF THE DECAYS OF K_2^0 MESONS INTO THREE NEUTRAL PIONS. A. S. Sleksanyan, A. I. Alikhanyan, A. M. Gal'per, R. L. Kavalov, V. G. Kirillev-Ugryumov, L. P. Kotenko, L. A. Kuzin, E. P. Kyznetsov, and G. I. Merzon (Lebedev Inst. of Physics, Moscow; Moscow Inst. of Engineering and Physics; and Inst. of Physics, Erevan). Zh. Eksperim. i Teor. Fiz., 46: 1504-7 (Apr. 1964). (In Russian)

The possible $K_2^0 \to 3\pi^0$ decay mode was investigated using a freon bubble chamber. Events containing from 3 through 6 electron-positron pairs directed approximately into one point and V events were analyzed. Distributions of the electron-positron pair events vs the emission parameter are given. Out of 194 pair events, 110 are $3\pi^0$ decays. The probability of $3\pi^0$ decay in relation to all K_2^0 decays is found to be 0.2 ± 0.06. (M.J.T.)

32628 WEAK INTERACTIONS. A. Pais (Inst. for Advanced Study, Princeton, N. J.). p.101-29 of "The Quantum Theory of Fields." New York, Interscience Publishers.

Weak interactions in leptonic $\Delta S = 0$ processes, leptonic $\Delta S \neq 0$ processes, and non-leptonic $|\Delta S| = 1$ processes are considered. A discussion of P and C violation, CP-invariance, T-invariance, CPT-invariance, two component neutrino theory, local action of lepton currents, lepton conservation, μ-e universality, the V-A law and the conserved vector current idea, $|\Delta S| = 1$, $|\Delta T| = \frac{1}{2}$, and $\Delta S/\Delta Q$ rules is included. (C.E.S.)

32629 THEORY AND APPLICATIONS OF SINGLE VARIABLE DISPERSION RELATIONS. M. L. Goldberger. p.179-208 of "The Quantum Theory of Fields." New York, Interscience Publishers.

Single variable dispersion relations are presented for the $\pi + N$, $\pi + \pi$, $\gamma + N$, $e + N$, $N + N$, $K + N$, and $\pi + d$ interactions. (C.E.S.)

32630 STUDY OF THE THREE-BODY LEPTONIC DECAY MODES OF THE K^+ MESON. Gary Lee Jensen (Univ. of Michigan, Ann Arbor). 116p. (CONF-481-66)

From American Physical Society Annual Meeting, New York, Jan. 1964.

K_{e3}^+ and $K_{\mu 3}^+$ decays of K^+ mesons are studied in a bubble chamber. The contributions of scalar, tensor, and vector interactions to the decays are determined. Information is given relating to the coupling constants for the interactions, and to the energy dependence of the form factors needed to describe the interactions. (T.F.H.)

Field Theory and Quantum Mechanics

32631 GEODESIC CORRESPONDENCE TRANSFORMATION AND INTERACTING FIELDS. Ying Chuan Yang (National Tsing Hua Univ., Taiwan). Chinese J. Phys. (Taiwan), 2: 42-5(Apr. 1964).

It is shown that by a geometric transformation of a flat space to a curved space the interactions of fields may be determined. In the transformation the coordinates are kept unchanged, since it is assumed that there is always a geodesic correspondence between the two spaces. The idea is illustrated by treating the cases of the gravitational, electromagnetic, and strong interactions. (auth)

32632 ON THE RADIATION OF CHARGED PARTICLE MOVING IN A NONSTATIONARY NONUNIFORM MEDIUM. K. A. Barsukov and B. M. Bolotovskii (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 291-9(1964). (In Russian)

Radiation is considered of a charged particle moving in

a medium whose parameters vary according to the travelling wave's law. The spectrum and the radiated energy were found. (auth)

32633 STUDIES IN PERTURBATION THEORY. II. GENERALIZATION OF THE BRILLOUIN-WIGNER FORMALISM. III. SOLUTION OF THE SCHRÖDINGER EQUATION UNDER A VARIATION OF A PARAMETER. Per-Olov Loewdin (Uppsala Univ. and Univ. of Florida, Gainesville). J. Mol. Spectry., 13: 326-37(July 1964).

The solution of the Schrödinger equation by means of the variation principle and a discrete basis leads to a certain secular equation. Previously it was shown that, if this equation is handled by a partitioning technique, a generalization of the Schrödinger-Brillouin formula is obtained. The procedure contains an inverse matrix, and it is shown that, if in the expression for the wave function this matrix is approximated to the nth order, the corresponding matrix in the expectation value for the energy is approximated to order (2n + 1). This gives a simple derivation and generalization of the Brillouin-Wigner theorem. The connection between the variation principle and perturbation theory is further discussed. The solution of the Schrödinger equation by means of the variation principle and a discrete but not necessarily orthonormal basis is studied in the case when the Hamiltonian H = H(α) is a function of a parameter α. The coefficients in the power series expansions in α of the wave function and the energy are explicitly determined in the form of expectation values, and the connection with the conventional Schrödinger theory is discussed. (auth)

32634 THE PRINCIPLES OF RELATIVITY AND OF EQUIVALENCE IN THE EINSTEINIAN GRAVITATION THEORY. [PART] I. V. Fock. Kgl. Norske Videnskab. Selskabs, Forh., 36: 16-21(1963).

The principles that constitute the foundations of the Einsteinian gravitation theory were analyzed to evaluate the logical structure of this theory. A general statement of the relativity principle is made. The concepts of the inertial frames of reference and the space-time metric are summarized. (J.S.R.)

32635 THE PRINCIPLES OF RELATIVITY AND OF EQUIVALENCE IN THE EINSTEINIAN GRAVITATION THEORY. [PART] II. V. Fock. Kgl. Norske Videnskab. Selskabs, Forh., 36: 22-7(1963).

The existence of the general relativity principle is questioned because of the argumentation that the general relativity principle is a generalization of the Galilean relativity principle to the case of an arbitrary accelerated motion of the frame of reference is considered fallacious. Analysis showed that the concepts of relativity and equivalence play only a restricted part in the theory of gravitation. The two basic principles of Einstein's gravitation theory are summarized. (J.S.R.)

32636 NEW ASPECTS IN CLASSICAL DYNAMICS. [PART] I. I. Fujiwara and P. Chr. Hemmer. Kgl. Norske Videnskab. Selskabs, Forh., 36: 46-8(1963).

Aspects in classical Lagrangian dynamics, which will be of fundamental importance in formulating quantum mechanics in terms of functional integration method, were investigated. The study was limited to the case of one-dimensional motion of a particle so that its position at any instant of time t is specified by the coordinate q(t). An auxiliary function $\beta(t)$ was introduced as a general solution to the linear second order differential equation $m\ddot{\beta}(t) + V^{(2)}(q)\beta(t) = 0$ and shown to be closely connected to the classical action integral or, more precisely, to its second derivative $\partial^2 S(y,x,\tau)/\partial y \partial x$. (J.S.R.)

32637 NEW ASPECTS IN CLASSICAL DYNAMICS. [PART] II. I. Fujiwara and P. Chr. Hemmer. Kgl. Norske Videnskab. Selskabs, Forh., 36: 49-52(1963).

The property of the Lagrangian function integrated along the fictitious path z(t), assumed independently of the Newtonian equation of motion and of terminal conditions, was investigated with respect to the time t from 0 to π. (J.S.R.)

32638 NEW ASPECTS IN CLASSICAL DYNAMICS. [PART] III. I. Fujiwara and P. Chr. Hemmer. Kgl. Norske Videnskab. Selskabs, Forh., 36: 53-6(1963).

The results obtained previously were generalized to a dynamic system characterized by the time-independent Lagrangian L[$\dot{q}$,q], which is not necessarily quadratic in the velocity $\dot{q}(t)$. The study was still restricted to one-dimensional motion of the system. (J.S.R.)

32639 NEW ASPECTS IN CLASSICAL DYNAMICS. [PART] IV. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 57-9(1963).

The results obtained previously were generalized to the case of a dynamic system with f degrees of freedom. The coordinate q(t) of the whole system and its canonically conjugate momentum are column matrices with f elements. (J.S.R.)

32640 NEW ASPECTS IN CLASSICAL DYNAMICS. [PART] V. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 60-3(1963).

The properties of the dynamic system along the fictitious path z(t), assumed independently of the equation of motion, were investigated. (J.S.R.)

32641 ON THE GREEN'S FUNCTION OF A PLANE REGION. Henrik L. Selberg. Kgl. Norske Videnskab. Selskabs, Forh., 36: 69-71(1963). (In German)

If S is a limited open point set of the real axis decaying at a finite number of intervals, no two of which coincide, and $\bar{S}$ is the complimentary set of S on the real axis and G_S is the slit range of the z = x + iy plane, whose space is $\bar{S}$, then by assuming that S contains z = 0, the properties of the Green function pertinent to the region G_S having it space point at z = 0 can be derived. (J.S.R.)

32642 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] I. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 72-6(1963).

A nonrelativistic particle in one dimension was considered and the transition probabilities computed. An exact form of the correspondence principle was derived and functional integration was performed. (M.C.G.)

32643 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] II. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 77-80(1963).

The functional integration method in quantum mechanics, mainly in connection to the correspondence principle, is considered from a technical point of view. The techniques for avoiding the difficulties involved in evaluating the functional integral to obtain the expansion in the quantum of action h are discussed. (J.S.R.)

32644 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] III. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 81-5(1963).

The Lagrangian L($\dot{z}$,z) in the exponent of the functional integrand was expanded around the classical path q(s) with end points q(0) = x and q(t) = y, the same as those of the fictitious path z(s). The study was limited to the case of a dynamic system with a single degree of freedom. (J.S.R.)

32645 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] IV. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 86-91(1963).

The functional integration method for the simple nonrelativistic Lagrangian $L(\dot{z},z)$ was completed. (J.S.R.)

32646 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] V. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 97-101(1963).

The functional integration method for quantum mechanics of a dynamic system with a single degree of freedom was generalized to the case of a system with an arbitrary but finite number of degrees of freedom. (J.S.R.)

32647 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] VI. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 102-6(1963).

The functional integration method for quantum mechanics of a system with f degrees of freedom was completed. (J.S.R.)

32648 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] VII. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 107-10(1963).

The functional integral $K(y,t;x,0) = \int d^f[z(s)]\ \varphi\ [z(s)|y,t;x,0]$ for a system with f degrees of freedom was evaluated by procedures slightly different from those used previously. (J.S.R.)

32649 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] VIII. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 111-14(1963).

The functional integration method for quantum mechanical treatment of a dynamic system with f degrees of freedom was directly generalized to the case of a system with an infinite number of degrees of freedom ($f \to \infty$) or a field. The presentation is restricted to an investigation of a field $q(\lambda)$ in one-dimensional space of a finite length $a[a > \lambda > 0]$. (J.S.R.)

32650 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] IX. I. Fujiwara. Kgl. Norske, Videnskab. Selskabs, Forh., 36: 115-20(1963).

A field in one-dimensional space of a finite length was quantized on the basis of the mathematical preliminaries on functional integration developed previously. (J.S.R.)

32651 CORRESPONDENCE PRINCIPLE AND FUNCTIONAL INTEGRATION METHOD IN QUANTUM MECHANICS. [PART] X. I. Fujiwara. Kgl. Norske Videnskab. Selskabs, Forh., 36: 121-6(1963).

The quantization of a field in one-dimensional space of a finite length was completed. (J.S.R.)

32652 ON THE GREEN'S FUNCTION OF MULTIPLE CONNECTED FIELDS. Henrik L. Selberg. Kgl. Norske Videnskab. Selskabs, Forh., 36: 177-84(1963). (In German)

The existence of a $g(z,\zeta;G)$, the Green's function pertinent to the field G of the complex z plane, was proved. (J.S.R.)

32653 GEOMETRY OF THE ELECTROMAGNETIC FIELD. R. M. Misra (Univ. of Gorakhpur, India). Nuovo Cimento (10), 32: 1561-83(June 16, 1964).

The Einstein-Maxwell field equations in presence of pressure and matter were considered for the case in which the electromagnetic field in nonnull. Every possible structure of R_μ^λ was analyzed from the point of view of geometry and physics. It was found that not every geometrically possible solution is admissible from the physical point of view. In every case F, μ, p and the basic vectors were represented as algebraic concomitants of the contracted curvature tensor R_μ^λ. (auth)

32654 ON THE WAVE MECHANICS OF GASES. L. Gold (Kennecott Copper, Lexington, Mass.). Nuovo Cimento (10), 32: 1622-8(June 16, 1964).

A low-density gas at reduced temperature must ultimately be described by quantum mechanics. The statistical mechanical treatment of such ensembles requires retention of summation forms to admit noncontinuum behavior. Anomalous specific heat is demonstrated with the prospect of multiple peaks for anisotropic energy surfaces. Moreover, an equation of states arises which reflects the presence of a zero-point translational energy, requiring departure from the ideal gas law as $T \to 0$. It is also shown that passage from wave-mechanical to kinetic theory of gases follows both simply via de Broglie's relation. (auth)

32655 BROKEN SYMMETRIES IN NONLINEAR SPINOR THEORIES. K. Ladányi (Research Group for Theoretical Physics, Budapest). Nuovo Cimento (10), 32: 1629-44 (June 16, 1964).

A possible breakdown of some invariances is discussed by considering nonlinear spinor theories. The mechanism is similar to the breakdown of the gauge-invariance in the theory of superconductivity. The possibility of the isospin and baryon number nonconservation is discussed in detail. The existence of a peculiar interaction ("soft" interaction) is predicted. This "soft" interaction is strong, nonisoinvariant, with significant charge asymmetry, short-ranged, characterized by the half of the nucleon Compton wavelength, and vanishes on the light cone. (auth)

32656 ON THE TRANSFORMATION OF RELATIVISTIC SINGLE-PARTICLE HAMILTONIANS TO ODD AND EVEN FORMS. A. Sankaranarayanan (Univ. of Madras). Nuovo Cimento (10), 32: 1715-20(June 16, 1964).

A reduction of the relativistic single-particle equations to even and odd forms is presented, and uniqueness is considered. (auth)

32657 RENORMALIZATION GROUP AND THE PHOTON PROPAGATOR. G. Bisiacchi, G. Furlan, A. Nocentini, and T. Weber (Università, Trieste, Italy). Nuovo Cimento (10), 32: 1742-54(June 16, 1964).

The equations of the renormalization group are applied to the perturbative expansion of the photon propagator in quantum electrodynamics. They are shown to correspond to a "coherence principle in the renormalization of the single graphs," and for this reason they cannot give, by themselves, any improvement of the perturbative expansion. This is no more the case if they are used together with an explicit assumption on the form of the propagator. Two conditions of this kind, which has been used in the literature, are discussed. (auth)

32658 QUANTIZATION OF NONLINEAR FIELD THEORIES AND SCALE TRANSFORMATION. H. Mitter (Max-Planck-Institut für Physik and Astrophysik, Munich). Nuovo Cimento (10), 32: 1789-1808(June 16, 1964). (TID-20327)

Certain nonlinear field equations are invariant with respect to the scale (dilatation) transformation. A quantum theory based on such an equation can be invariant only if it does not contain states with finite rest mass. The invariance could, however, show up at high energies and momentum transfers (short distances), where rest masses

are negligible. The consequences of this asymptotic invariance for the n-point functions are studied. The functions are in general less singular than in perturbation theory. As a consequence, the metric in the space of states is indefinite. The problem of compatibility of the invariance with locality and the equations of motion is treated in a very rough approximation only. (auth)

32659 COSMOLOGY AND WEAK INTERACTIONS. J. S. Dowker (Univ. of Manchester, Eng.). Nuovo Cimento (10), 32: 1816-18(June 16, 1964).

The cosmological implications of fields with nonvanishing vacuum expectation values are examined by calculations for the case of a nonvanishing expectation value of the scalar K^0 field. (D.C.W.)

32660 ON THE GRAVITATIONAL RADIATION OF MICROSCOPIC SYSTEMS. L. Halpern (Universitet, Copenhagen) and B. Laurent. Nuovo Cimento (10), 33: 728-51(Aug. 1, 1964).

The properties of electromagnetic and gravitational multipole radiation are compared. The gravitational field and its interaction with matter is treated within the linearized theory. Application is made to the emission and absorption of gravitons by microscopic systems such as molecules and nuclei. Processes leading to their production and detection are described. The intensity of gravitational radiation resulting from such processes taking place in celestial bodies is determined. The possibility of increasing the graviton flux by stimulated emission is discussed. (auth)

32661 ON FINZI'S HYPOTHESIS ABOUT THE LONG-RANGE BEHAVIOR OF NEWTONIAN FORCE. Shin Yabushita (Univ. of Maryland, College Park). Nuovo Cimento (10), 33: 769-75(Aug. 1, 1964).

Finzi's hypothesis (Nuovo Cimento, 28: 224(1963)) that the inverse square law of Newtonian force may have to be modified at cosmical distances is criticized by considering the fluctuation of force due to a random distribution of galaxies. It is shown within the framework of Newtonian dynamics that if the long-range force is proportional to $(\text{distance})^{-n}$, where n is less than 1.5, the expectation value of the force acting at any point is infinitely large if the universe is an infinitely-large, uniform space. (auth)

32662 ON THE THEORY OF THE 2n-POINT FUNCTION FOR HEISENBERG'S NONLINEAR FIELD. V. Gorini (Università, Milan) and E. Montaldi. Nuovo Cimento (10), 33: 809-52(Aug. 1, 1964).

The theory of the four-point function for Heisenberg's basic field of matter is developed in its formulation by means of Weyl isospinors. The formalism is then extended to the treatment of the 2n-point function of which a spectral representation is given that displays all the symmetry properties of the fundamental equation. The connection with the $(2n-2)$-point function, which requires certain symmetry properties and regularization integral conditions for the mass spectra, is investigated in detail in the particular case $n = 3$. (auth)

32663 EXPLORATION OF S-MATRIX THEORY. David I. Olive (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 135: B745-60(Aug. 10, 1964).

The possibility of constructing an S-matrix theory from postulates concerning unitarity, analyticity, connectedness, the $i\epsilon$ prescription and the spin-statistics connection is explored. The existence and residues of the physical region poles are shown to follow from the connected unitarity equations. The validity of certain fundamental theorems known from field theory, Hermitian analyticity, extended unitarity, the existence of antiparticles, the substitution law for crossed processes and the TCP theorem is reduced, in simple cases, to the question of whether the S-matrix singularity structure permits specific distortions of certain paths. These distortions are shown to be possible in a model singularity structure consisting of the normal thresholds, and depend only upon simple properties of these singularities. It is explained that it is logically impossible to deduce the complete singularity structure without these results. A suggested resolution of this difficulty is to set up a scheme of successive iterations in singularity structure to be justified by self-consistency. (auth)

32664 FIELD THEORY OF MATTER. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev., 135: B816-30(Aug. 10, 1964).

A spectulative field theory of matter is developed. Simple computational methods are used in a preliminary survey of its consequences. The theory exploits the known properties of leptons by means of a principle of symmetry between electrical and nucleonic charge. There are fundamental fields with spins 0, ½, 1. The spinless field is neutral. Spin ½ and 1 fields can carry both electrical and nucleonic charge. The multiplicity of any nonzero charge is 3. Explicit dynamical mechanisms for the breakdown of unitary symmetry and for the muon-electron mass difference are given. A more general view of lepton properties is proposed. Mass relations for baryon and meson multiplets are derived, together with approximate couplings among the multiplets. The weakness of ϕ production in $\pi-N$ collisions and the suppression of the $\phi \to \rho + \pi$ decay is explained. (auth)

32665 POSSIBLE CONNECTION BETWEEN GRAVITATION AND FUNDAMENTAL LENGTH. C. Alden Mead (Univ. of Minnesota, Minneapolis). Phys. Rev., 135: B849-62(Aug. 10, 1964).

An analysis of the effect of gravitation on hypothetical experiments indicates that it is impossible to measure the position of a particle with error less than $\Delta x \gtrsim \sqrt{G} = 1.6 \times 10^{-33}$ cm, where G is the gravitational constant in natural units. A similar limitation applies to the precise synchronization of clocks. It is possible that this result may aid in the solution of the divergence problems of field theory. An equivalence is established between the postulate of a fundamental length and a postulate about gravitational field fluctuations, and it is suggested that the formulation of a fundamental length theory which does not involve gravitational effects in an important way may be impossible. (auth)

32666 GRAVITY: A UNIVERSAL REGULATOR? Bryce S. DeWitt (Princeton Univ., N. J. and Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Letters, 13: 114-18(July 20, 1964).

Results, which tend to confirm the speculation that quantum gravidynamics may remove the divergences in conventional field theories by providing a natural cutoff associated with the well known fundamental length 10^{-33} cm, are obtained for the case of two scalar particles exchanging gravitons in the ladder approximation. (L.B.S.)

32667 EFFECTS OF QUANTIZING MAGNETIC FIELD ON AUTOELECTRON EMISSION. Sh. M. Kogan and V. B. Sandomirskii. Radiotekhn. i Elektron., 9: 724-7(Apr. 1964). (In Russian)

Superposition of a quantizing magnetic field alters the energy spectra of electrons in a solid and influences autoelectron emission. Expressions were developed for the autoelectron flow and the energy distribution of electrons in the presence of a quantizing magnetic field. (tr-auth)

32668 ON THE ONE-BODY PROBLEM IN THE DIFFERENT THEORIES OF GRAVITATION. Paul Kustaanheimo and Raimo Lehti (Astronomisches Observatorium, Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 28: No. 2, 1-20(1963). (In German)

It is shown that the one-body problem of any theory of gravitation admits two integrals, which correspond to the energy and areal integrals, and that the orbits can thus be calculated by quadratures, if only four formal assumptions are satisfied. The physical structure of the theory in question influences solely the values of four constants in these integrals. If the theory in question is based on a flat Minkowski space-time, the number of these free constants is reduced to two. The relativistic dilatation of the sidereal period of orbits with great eccentricity, the deflection of light rays, and the perihelion advancement depend on these constants. If the space-time is flat, the observed values of the effects mentioned must thus satisfy an identity. If the space-time is curved according to the Schwarzschild line-element, another identity must be satisfied. (auth)

32669 RELATIVISTIC QUANTUM MECHANICS. James D. Bjorken and Sidney D. Drell. International Series in Pure and Applied Physics. New York, McGraw-Hill Book Company, 1964. 312p. $11.50.

A propagator approach to relativistic quantum mechanics is presented. The topics discussed include the Dirac equation, Lorentz covariance of the Dirac equation, solutions to the Dirac equation for a free particle, the Foldy-Wouthuysen transformation, hole theory, propagator theory, higher-order corrections to the scattering matrix, the Klein-Gordon equation, nonelectromagnetic interactions, and Feynman graphs. (C.E.S.)

32670 THE COMPLEX j-PLANE. COMPLEX ANGULAR MOMENTUM IN NONRELATIVISTIC QUANTUM SCATTERING THEORY. Roger W. Newton. The Mathematical Physics Monograph Series. New York, W. A. Benjamin, Inc., 1964. 243p. $9.00(Cloth Edition); $4.95 (Paperback).

The mathematical technique of complex angular momentum, introduced into quantum mechanics by T. Regge, is described. Areas included in the discussion are those in which mathematical proofs are based on well-established dynamics. A complete review of the application of the complex angular momentum technique to the Schroedinger theory is given. Numerical results of various applications are given. Numerous references. (R.E.U.)

32671 POLEVYE METODY TEORII MNOGIKH CHASTITS. (Field Methods of the Theory of Many Particles). D. A. Kirzhnits. Moscow, Gosatomizdat, 1963. 345p.

Basic information on quantum mechanics—the Schroedinger equation and the classification of many-particle systems, representation theory, and representation of occupation numbers—is reviewed. Hartree-Fock and Thomas-Fermi approximations and their applications to theories of dense materials and atomic nuclei are considered. Perturbation theory and diagram techniques, with the scattering matrix and Feynman rule, are discussed. The Green function method in quantum mechanics and in quantum statistics, spectral representations, quasiparticles, theories of rarefied and dense many-particle systems, and applications to theories of collective oscillations and plasma are discussed. (M.J.T.)

32672 THE QUANTUM THEORY OF FIELDS. Proceedings of the Twelfth Conference on Physics at the University of Brussels, October 1961. New York, Interscience Publishers, 1961. 261p.

Physical aspects of quantum field theory, the present status of quantum electrodynamics, weak interactions, symmetry properties of fields, aspects of the formalism of field theory, theory and applications of single variable dispersion relations, two-dimensional representations of scattering amplitudes, and extensions and modifications of quantum field theory were discussed. Separate abstracts are prepared for all of the papers presented. (C.E.S.)

For abstracts of individual papers see: 32628, 32629, 32673, 32674, 32675, 32676, 32677, and 32678.

32673 PHYSICAL ASPECTS OF QUANTUM-FIELD THEORY. W. Heitler. p.37-60 of "The Quantum Theory of Fields." New York, Interscience Publishers.

Difficulties encountered in the development of quantum field theory are discussed. Two kinds of field theory, the strictly invariant but divergent renormalization theory and a convergent but not strictly invariant theory, are compared. The non-relativistic extended source and mass differences are also considered. (C.E.S.)

32674 THE PRESENT STATUS OF QUANTUM ELECTRODYNAMICS. Richard P. Feynman (California Inst. of Tech., Pasadena). p.61-99 of "The Quantum Theory of Fields." New York, Interscience Publishers.

Quantum electrodynamic calculations are compared with experimental results, and some of the unanswered theoretical questions in this field are considered. High-energy experiments, energy levels in hydrogen, the anomalous magnetic moment of the electron and meson(μ), positronium, self-energy, the electron mass and charge, elementary particle interactions, and dispersion theory are discussed. (C.E.S.)

32675 SYMMETRY PROPERTIES OF FIELDS. Murray Gell-Mann (California Inst. of Tech., Pasadena). p.131-46 of "The Quantum Theory of Fields." New York, Interscience Publishers.

The exact and approximate symmetry properties of elementary particle field theory are discussed. (C.E.S.)

32676 SOME ASPECTS OF THE FORMALISM OF FIELD THEORY. Gunnar Kaellen. p.147-78 of "The Quantum Theory of Fields." New York, Interscience Publishers.

An axiomatic approach to field theory is outlined. Lorentz invariance, a reasonable mass spectrum, local commutativity, and an asymptotic condition are assumed, and the consequences of these assumptions are discussed. (C.E.S.)

32677 TWO-DIMENSIONAL REPRESENTATIONS OF SCATTERING AMPLITUDES AND THEIR APPLICATIONS. S. Mandelstam. p.209-33 of "The Quantum Theory of Fields." New York, Interscience Publishers.

The foundations of two-dimensional representations and of the analytic properties of transition amplitudes are discussed. The results obtained with the representations in conjunction with approximation schemes are considered. Proposals for overcoming some of the more serious difficulties of the approximation scheme are outlined. (C.E.S.)

32678 EXTENSIONS AND MODIFICATIONS OF QUANTUM FIELD THEORY. Hideki Yukawa (Kyoto

Univ.). p.235-51 of "The Quantum Theory of Fields." New York, Interscience Publishers.

The development of a quantum field theory that is free from logical and structural defects and that is able to give cogent reasons for the existence and interactions of various types of particles is discussed. A field theory that satisfies the conditions of Lorentz invariance, convergence, probabilistic interpretation, and macroscopic causality is considered. (C.E.S.)

Geophysics

Refer also to abstract 32357.

32679 (AD-428169) SUDDEN IONOSPHERIC DISTURBANCES AND THE PROPAGATION OF VERY-LOW-FREQUENCY RADIO WAVES. PART 1. PHENOMENOLOGY AND RELEVANT IONOSPHERIC THEORY. Final Report. Edward T. Pierce and Helen R. Arnold (Stanford Research Inst., Menlo Park, Calif.). July 1963. Contract AF49(638)-1081. 145p.

The changes in vlf radio noise accompanying a solar flare and its associated sudden ionospheric disturbance (SID) are surveyed. The onset time of the effects is about 10 minutes, but may be less than 2 minutes for perhaps 5 percent of the incidents. The alteration in propagation conditions implies an increase in noise on frequencies exceeding 20 kc and a decrease below 10 kc. If a local thunderstorm develops, the time phasing is very similar to that of an SID incident, but noise at all frequencies is enhanced. A detailed examination of the formative processes of the lower ionosphere is made. Values of the rate coefficients for attachment, detachment (photo, collisional, and associative), electron-ion recombination, and ion-ion recombination, are deduced for heights from 40 to 100 km. Over the same height range, the ionizing contributions due to the major influences of cosmic rays, solar x rays, and solar Lyman α and to certain subsidiary causes are examined. The balance equations for the lower ionosphere are solved for the cases of equilibrium conditions and of the departure from equilibrium associated with the approach of night. Two specific examples indicate that contours of electron density, and therefore of ionospheric conductivity, are far from parallel to the surface of the earth. It follows that the attenuation coefficient for vlf propagation by day can differ according to the solar zenith angle by as much as 20 percent from the mean daytime value. A model of the solar x-ray flux during a flare is derived and its ionizing effects examined. The flux peaks in 5 minutes but it is found that the maximum ionospheric effect lags behind, especially at the lower heights. Surprisingly enough, the persistence of the added ionization does not increase monotonically with increasing height. The ionization produced by an x-ray burst from a nuclear explosion in space is deduced. Differences in the onset phase, the spectral distribution of the x rays, and the zenith-angle dependence, as compared with a natural SID, are demonstrated. The decay of the additional ionization is examined and it is shown that this often involves three phases: the establishment of an attachment-detachment balance, a plateau with little decay, and a final decrease by recombination. An example indicates that if the same amount of extra ionization is introduced at heights of 70, 75, and 80 km, then, after about an hour, more of the additional ionization remains at 70 km than at either of the other heights. (auth)

32680 SUNSPOT-CYCLE CONTROL OF IONOSPHERIC AND GEOMAGNETIC VARIATIONS. Edward Appleton (Univ. of Edinburgh). J. Atmospheric and Terrest. Phys., 26: 633-40(June 1964).

Using two long-term geophysical time series of ionospheric and geomagnetic measurements, made at substantially the same site, the seasonal and sunspot-cycle variations of the E-layer ionization and the intensity of the S_q overhead current were compared. If the E-layer ionization is expressed in terms of its critical penetration frequency, fE, it is found that $(fE)^2 = 10.2 \sqrt{\cos \chi}\,(1 + 0.0039 R)$, where fE is measured in Mc/s, χ is the sun's zenith distance, and R is the Zürich sunspot number. A corresponding investigation of the geomagnetic component Y of the S_q system leads to the relation $Y = 60 \cos \chi\,(1 + 0.0039 R)$. The fact that the E-layer is the only stratum in the ionosphere whose sunspot-cycle variation is identical with the corresponding variation in S_q leads to the conclusion that the S_q overhead currents actually flow at the E-layer level. (auth)

32681 A TIME-VARYING MODEL OF THE IONOSPHERIC F2-LAYER. H. Rishbeth (National Bureau of Standards, Boulder, Colo.). J. Atmospheric and Terrest. Phys., 26: 657-85(June 1964).

A model of the quiet F2 layer at mid-latitudes is presented, which combines time-dependent solutions of the F2-layer continuity equation in a static atmosphere with time-varying atmospheric models. The analysis makes use of the fact that the diurnal variations of the photoionization rate, and of the loss and diffusion coefficients, become relatively simple when considered in terms of fixed pressure levels. The rates used for this model provide a good representation of the F2 layer, especially by day. Several published values of production and loss rates at 300 km, for different levels of solar activity, are compared and found to be reasonably consistent. However, these rates are regarded as being determined only to within a factor of two. Not all F2-layer phenomena can be explained by the model. In particular, there are difficulties in accounting for the behavior of the F2 layer at night, and these may indicate that the layer is maintained by slow downward diffusion of exospheric ionization or by corpuscular ionization. (auth)

32682 THE OBSERVATION OF AMPLITUDE VARIATIONS IN SWEPT FREQUENCY SIGNALS FROM THE IONOSPHERIC E- AND F-REGIONS. L. H. Heisler (Univ. of Sydney). J. Atmospheric and Terrest. Phys., 26: 687-93(June 1964).

An ionosonde developed at the Sydney Laboratory of Radio Research Board, was modified to provide recording of received signal amplitude as the recorder is swept rapidly over a range of frequencies. Movements of amplitude peaks in both F- and E_s-ionogram traces were used to derive information on fine structure of perturbations of ion density in these regions. (auth)

32683 ON THE SOLAR FLARE EFFECT OF v.l.f.-WAVES IN THE LOWER IONOSPHERE. Hans Volland (Heinrich-Hertz Inst., Berlin). J. Atmospheric and Terrest. Phys., 26: 695-709(June 1964).

The change of the equivalent reflection height h' with time was determined from 15 selected solar flare effects of the transmitter GBR (16 kc/s) measured in Berlin. With the help of a plausible ionospheric model it is possible to assign to each h' a corresponding electron density N. The parameters of an effective recombination law and an effective assignment law were determined from the time variation of h'. If the normal D layer becomes enlarged during a solar flare, only the assignment law is applicable. The average effective assignment coefficient is $\beta = 3.4 \times 10^{-3}$

sec^{-1} at 70 km. If a new layer produced by x rays is built up during a solar flare below the normal D layer, the recombination law achieves validity. The average value of the product of the effective recombination coefficient α and the normal electron density N_0 is $\alpha N_0 = 2.9 \times 10^{-4}$ sec^{-1} at 70 km. (auth)

32684 PROPAGATION OF WEAK HYDROMAGNETIC SHOCK WAVES IN THE EXOSPHERE AND GEOMAGNETIC VARIATIONS DUE TO HIGH ALTITUDE NUCLEAR EXPLOSION. Toru Araki (Kyoto Univ.). J. Geomagnet. Geoelec., 15: 126-32(Feb. 1964).

Propagation paths are calculated for weak hydromagnetic shock waves (fast mode) from a point source lower than 3000 km above sea level. It is shown that shock waves of this type have a tendency to propagate easily in the direction of the geomagnetic meridian. The results are compared with the observed geomagnetic disturbances due to the small-scale high-altitude nuclear explosion (Argus III). A qualitative agreement is obtained between the theoretical and the observational results. (auth)

32685 PERIODIC PRECIPITATION OF THE PARTICLE FLUX IN THE AURORAL ZONE. R. N. Singh (Univ. of Alaska, College). Nature, 203: 69(July 4, 1964).

A possible mechanism for the periodic precipitation of the particle flux in the auroral zone is proposed, and its validity and limitations are discussed. (C.E.S.)

32686 AURORA RESEARCH USING SATELLITES. R. D. Moffat (Lockheed Missiles and Space Co., Palo Alto, Calif.). Nucl. Instr. Methods, 28: 79-87(June 1964).

A polar satellite program of auroral measurements is described. The particle flux above an aurora and the profiles of optical radiation and electron density in the aurora were simultaneously measured to study atomic processes and recombination rates in the upper atmosphere and to assess the magnetospheric mechanisms related to auroras. Simultaneous observations were made on auroras with a combination of satellite, aircraft, and ground instruments. The possible production of artificial auroras with a flying accelerator is also discussed. (D.C.W.)

32687 DYNAMICS, COMPOSITION, AND ORIGIN OF GEOMAGNETICALLY TRAPPED RADIATION. James A. Van Allen (Iowa State Univ., Iowa City). p.226-74 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

A historical summary of the experimental and theoretical aspects of geomagnetically trapped radiation is presented. Theoretical deduction prior to the discovery of the radiation belts, the role of adiabatic invariants in geomagnetic trapping, the natural system of coordinates for trapped particles, the intensity structure of the radiation region, sources of trapped particles in the inner zone, and sources of trapped particles and/or kinetic energy in the outer zone are discussed. (C.E.S.)

32688 THE DYNAMICS OF THE OUTER RADIATION ZONE. Alan Rosen (Space Technology Labs., Inc., Los Angeles). p.275-315 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

Experimental observation and interpretation of dynamic mechanisms active in the earth's trapped radiation zones are discussed. The inner and outer radiation zones, equations of motion, motion of particles in the radiation belt, injection and trapping of particles, lifetime of trapped particles, neutron albedo injection, pitch-angle distribution and the neutron-albedo theory, and solar injection are considered. (C.E.S.)

32689 THEORETICAL AND EXPERIMENTAL ASPECTS OF RING CURRENTS. Edward J. Smith (California Inst. of Tech., Pasadena). p.316-73 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The possible existence of a geomagnetic ring current is considered. The Störmer, Chapman-Ferraro, Alfvén, and modern ring-current theories are discussed. Experimental evidence of the existence of the ring current is presented. (C.E.S.)

32690 THE EARTH'S EXOSPHERE. S. Fred Singer (U. S. Weather Bureau, Washington, D. C.). p.522-48 of "Space Science." New York, John Wiley & Sons, Inc., 1963.

The escape of gases from a planetary atmosphere, the distribution of density in a neutral exosphere, distribution of the neutral and ionized components of the exosphere, and the distribution of ionized oxygen and hydrogen are discussed. (C.E.S.)

Low Temperature Physics

32691 (JPRS-25289) STUDIES IN SOVIET METALLURGY. Translated from Tr. Inst. Met. im. A. A. Baikova, Akad. Nauk SSSR, No. 6, 41-53(1960). 21p. (TT-64-31580)

Two selected articles are presented on the electron spectra of superconductors and the x-ray spectra of superconducting CuS, respectively. Separate abstracts were prepared for both articles. (D.L.C.)

For abstracts of individual papers see: 32692 and 32693.

32692 (JPRS-25289(p.1-13)) CERTAIN FEATURES OF THE ELECTRON SPECTRUM OF SUPERCONDUCTORS. I. B. Borovskii (Borovskiy). Translated from Tr. Inst. Met. im. A. A. Baikova, Akad. Nauk SSSR, No. 6, 41-8(1960).

The electron-phonon interactions near the Fermi surface in superconductors are discussed. X-ray spectra of $CoSi_2$ and CuS were used to study the characteristics of the electron energy spectrum which are inherent to the superconducting state. The results show that a necessary (but not sufficient) condition for the formation of superconductors from nonsuperconductive elements is proximity of the electron spectra. (D.L.C.)

32693 (JPRS-25289(p.14-20)) X-RAY SPECTRA OF THE SUPERCONDUCTING COMPOUND CuS. I. B. Borovskii (Borovskiy) and I. A. Ovsyannikov. Translated from Tr. Inst. Met. im. A. A. Baikova, Akad. Nauk SSSR, No. 6, 49-53(1960).

Results are presented of a study of the substructure of x-ray K-absorption and emission spectra of S and Cu in pure elements and superconducting CuS. The results show that the electron structure of the ionic remainder of Cu in CuS is $3d^{10}$ and the conduction band contains an average of 2 electrons per atom. The results also confirm the assumption of correlations between the electron energy spectrum of a superconductor and its superconducting properties. (D.L.C.)

32694 CALCULATION OF THE PENETRATION DEPTH AND THERMOELECTRIC EFFECT FOR ANISOTROPIC SUPERCONDUCTORS. V. A. Litovchenko (Univ. of Friendship of Nations imeni Patrice Lumumba, Moscow). Fiz. Tverd. Tela, 6: 1051-61(Apr. 1964).

The penetration depth of a magnetic field for two types of anisotropic superconductors was calculated: with an

open Fermi surface (cylinder) and closed (rotational ellipsoid). The thermoelectric effect was considered; expressions were obtained for a magnetic field and total current in the anisotropic superconductor in which there is a temperature gradient dependent on the coordinate. (OTS)

32695 TRANSVERSE PARAMAGNETIC EFFECT IN AN IRREVERSIBLE TYPE II SUPERCONDUCTOR. M. A. R. LeBlanc (Univ. of Southern California, Los Angeles). Phys. Letters, 10: 260-1(June 15, 1964).

Observations of a paramagnetic moment parallel to an external field, occurring in a hard superconducting when a transport current transverse to the field is introduced after cooling through T_c in the presence of the field, are described. Interpretation of this phenomenon in terms of the Bean model yields results in qualitative agreement with the experimental data. (L.B.S.)

32696 SELF-DETECTION OF THE ac JOSEPHSON CURRENT. R. E. Eck, D. J. Scalapino, and B. N. Taylor (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 13: 15-18(July 6, 1964).

A temperature-independent resonance-shaped peak at applied voltages less than the energy gap was observed in current-voltage measurements on Pb–(Pb oxide)–Pb superconducting tunnel junctions exhibiting d-c Josephson currents. This structure is apparent at low temperatures and in a magnetic field large enought to quench the d-c Josephson current. The voltage at the peak is a linear function of the applied magnetic field, and the peak height is a function of magnetic field and of the magnitude of the zero-field d-c Josephson current. These variations are explained by a consideration of the coupling of the Josephson a-c current to the electromagnetic modes of the junction. (M.J.T.)

32697 EFFECT OF ELECTRON CONCENTRATION ON MAGNETIC EXCHANGE INTERACTIONS IN RARE EARTH CHALCOGENIDES. F. Holtzberg, T. R. McGuire, S. Methfessel, and J. C. Suits (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev. Letters, 13: 18-21(July 6, 1964).

The relation between magnetic transition temperature and electrical properties, which can be inferred from the theory of indirect exchange via conduction electrons, was examined in semiconducting lanthanide compounds. Partial replacement of divalent Eu ions by trivalent lanthanides such as Gd, Tb, Dy, Lu, La, and Y was found to increase sharply the paramagnetic Curie temperature of Eu chalcogenides in the low concentration range, where the metal is still semiconducting. The Curie-temperature variation in metallic samples with higher trivalent ion concentrations agrees with the assumption of indirect exchange interaction via conduction electrons in the 5d level. The magnetic and electric behavior of pseudobinary solid solutions between the semiconducting rocksalt compound EuSe and the metallic rocksalt compounds GdSe and LaSe is reported. (M.J.T.)

32698 QUANTIZED FLUX PINNING IN SUPERCONDUCTING NIOBIUM. J. E. Zimmerman and J. E. Mercereau (Ford Motor Co., Dearborn, Mich.). Phys. Rev. Letters, 13: 125-6(July 27, 1964).

Direct experimental evidence for quantized flux pinning in superconducting niobium in localized units of h/2e is reported. The experimental concept is based on the utilization of quantum interference effects in superconductors as a flux detector. A two-contact superconducting quantum interferometer was used to measure the flux pinned in a niobium wire passing through the interferometer. Flux was pinned in a section of the wire by applying a longitudinal magnetic field and at the same time momentarily raising that section of wire above the transition temperature. (C.E.S.)

32699 SUPERCONDUCTIVITY OF INTERMETALLIC COMPOUNDS WITH NaCl-TYPE AND RELATED STRUCTURES. S. Geller and G. W. Hull, Jr. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 13: 127-9(July 27, 1964).

It is shown that intermetallic compounds with NaCl-type and related structures will be metallic and apparently superconductors provided there are cations present in two valence states, the lower of which is less stable than the higher. Lattice constants, carrier concentration, and critical temperature are given for intermetallic compounds InTe, AgInTe, InTeAs, SnAs, and SnSb. It is also shown that the superconducting transition temperature is dependent on the carrier concentration. (C.E.S.)

32700 MAGNETORESISTANCE EFFECT IN ADVANCE AND EVANOHM WIRES AT LOW TEMPERATURES IN FIELDS UP TO 50 kG. E. Lerner and J. G. Daunt (Ohio State Univ., Columbus). Rev. Sci. Instr., 35: 1069-70 (Aug. 1964).

The electric resistivity of wires of materials commonly used in cryostats was measured as a function of temperature. The isothermal magnetoresistance effect ($\Delta\rho/\rho$, where $\Delta\rho$ is the difference between the resistivity in a magnetic field and the resistivity ρ in zero magnetic field at the same temperature) was investigated at 4.2°K for fields up to 50 kgauss. No effect was observed for the Evanohm wire (Ni–Cu), while for Advance wire (Ni–Cr–Al–Cu) the effect was negative and almost equal for both longitudinal and transverse fields. (D.C.W.)

32701 RESISTANCE MINIMUM IN EVANOHM WIRE. R. C. Pandorf, E. Lerner, and J. G. Daunt (Ohio State Univ., Columbus). Rev. Sci. Instr., 35: 1070(Aug. 1964).

The ratio of the electrical resistivity of Evanohm wire (Al–Cu–Cr–Ni) between 0.3 and 4.2°K to its resistivity at 293°K in zero magnetic fields was obtained as a function of temperature. The observed temperature coefficient of resistance at about 0.5°K was about $0.003°K^{-1}$. (D.C.W.)

32702 SUPERCONDUCTIVITY OF Mo_3Al_2C. Jean Johnston, Louis Toth, Kurt Kennedy, and Earl R. Parker (Univ. of California, Berkeley). Solid State Commun., 2: 123(1964). (UCRL-11320)

The superconducting transition temperature of Mo_3Al_2C is measured as 10.0°K. No superconducting transition is observed in M_3Al_2C above 4.2°K (M = Nb, Ta, V, Ti, or Cr). The crystal structures and parameters for all 6 of these compounds are measured. (T.F.H.)

32703 SIZE-DEPENDENT ULTRASONIC ABSORPTION IN SUPERFLUID HELIUM. Klaus Dransfeld (Universität, Freiburg i. B.). Z. Physik, 179: 525-7(1964).

Ultrasonic waves in liquid He II at temperatures below 0.6°K can be absorbed by thermal phonons in 3- or 4-phonon processes. For the case that the mean free path of thermal phonons is sufficiently long 3-phonon processes are generally excluded because energy and momentum cannot be conserved. The conservation requirements cannot be fullfilled because the group velocity of thermal phonons is lower than the ultrasonic velocity due to dispersion. In small samples of liquid the uncertainty in phonon energy is shown to prevent a violation of the conservation laws for 3-phonon processes. In small volumes of liquid, ultrasonic waves are therefore strongly absorbed in 3-phonon pro-

cesses, while in larger volumes of liquid this contribution to the absorption is absent. A similar size dependent absorption is to be expected for longitudinal waves at low temperatures in ideal crystals. (auth)

32704 ON THE SUPERCONDUCTIVITY OF PACKED LAYERS OF NORMAL AND SUPERCONDUCTORS. Peter Hilsch and R. Hilsch (Universitat, Gottingen, Ger.). Z. Physik, 180: 10-31(1964). (In German)

Superimposed films of a superconducting and a normal-conducting metal were produced on a quartz plate by evaporation. In most cases lead and occasionally also tin was used as superconductor. The normal metals were copper, manganese, and chromium. For more than 50 samples of different combinations the transition temperatures were measured. The mean free path of the electrons for the metals could be varied by the conditions of condensation. By means of a phenomenological theory, based on a principle obtained in a discussion with Professor Fröhlich, Liverpool, expressions were formulated for $t = f(D_s, D_n, l_s, l_n, \xi_0)$. D, l and ξ_0 are the thickness, mean free path, and the coherence length of the supra- or the normal metals and t is the reduced transition temperature. The developed equations can be well fitted to the measured data and also to results of other authors. (auth)

32705 ON ABRIKOSOV'S THEORY OF THE PERIODIC SOLUTION OF GL EQUATIONS FOR SUPERCONDUCTORS OF SECOND TYPE. Gert Eilenberger (Universität, Gottingen, Ger.). Z. Physik, 180: 32-42(1964). (In German)

Abrikosov's method to get periodic solutions of the GL-equations (Ginzburg-Randau) for superconductors of type II was reformulated in order to make higher approximations possible. It is shown that instead of the external magnetic field, the average field in the superconductor must be used as fixed quantity in the approximations; then the method can be extended to a general iteration procedure with a fixed period parallelogram for the solution. In the first approximation every periodic solution is given by a simple product of ϑ-functions; among those solutions which possess one flux quantum per period parallelogram only, the hexagonal modification has the lowest free energy as already proposed by Kleiner et al. (auth)

32706 STUDY OF THE TEMPERATURE DEPENDENCE OF Gd SATURATION MAGNETIZATION. V. E. Rode, R. Gerrmann, and L. M. Korolev (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1507-8(Apr. 1964). (In Russian)

The temperature dependence of the saturation magnetization of Gd was investigated in the temperature range 4.2 to 30°K. The magnetization jump ΔI was measured for the temperature change from T to liquid He temperature, using a constant magnetic field of 18,600 Oe. The experimental dependence of ΔI on T is presented. The data do not agree with the usual law $I = I_0 (1 - CT^{3/2})$. The data can be fitted by a law for ferromagnets with hexagonal close packed structure, $I = I_0 - AT^{3/2} \exp(-\Delta/T)$, by a proper choice of A and Δ. The data and this theoretical curve are compared with the curve from the Bloch law. (M.J.T.)

32707 ON THE SUPERFLUIDITY OF ^{3}He. V. P. Peshkov (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1510-13(Apr. 1964). (In Russian)

Superfluid ^{3}He was obtained by a three-step process of adiabatic demagnetization of paramagnetic salts. Curves of the thermal-capacity variation with temperature are presented for five experiments. The temperature dependence of the heat capacity for the empty capsule and for the capsule filled with liquid ^{4}He are the same. If in the ^{3}He-filled capsule, enough ^{3}He is condensed, then at $T > 0.005°$ the heat capacities of the empty and filled capsules almost coincide, but at $T < 0.005°$ the ^{3}He-filled capsule has a smaller capacity. ^{3}He heat capacities, obtained as the difference of values for the capsules filled with 1.12 and with 0.058 cm^3 liquid ^{3}He, are presented. The results are explained by the transition of liquid ^{3}He at $T \approx 0.0055°$ into the superfluid state. Results agree with theoretical calculations. (M.J.T.)

32708 CRYOGENICS. RESEARCH AND APPLICATIONS. Marshall Sittig. Princeton, New Jersey, D. Van Nostrand Company Inc., 1963. 228p. $6.75.

Properties and applications of cryogenic systems and materials are discussed. 136 drawings are given on the construction and operation of cryogenic systems. Numerous references. (R.E.U.)

Neutron Physics

Refer also to abstract 33010.

32709 (A/CONF.28/P/261) DEVELOPMENTS IN NEUTRON TRANSPORT THEORY. G. I. Bell (Los Alamos Scientific Lab., N. Mex.), B. G. Carlson, and K. D. Lathrop. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Mathematical methods in the treatment of the linear Boltzmann equation and associated integral equations in neutron transport theory are reviewed. Numerical methods are discussed. Discrete ordinates and polynomial, integral, and anisotropic methods are considered. (R.E.U.)

32710 (AEEW-R-370) THE CALCULATION OF CELL-AVERAGED DIFFUSION COEFFICIENTS. S. Francescon and I. C. Pull (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1964. 16p.

A new theory of leakage in heterogeneous systems was recently introduced in which the derivation of cell-averaged diffusion coefficients for use in whole reactor calculations is reduced to the calculation of a flux, ξ, arising from a tilted source in one lattice cell only. The manner in which an existing transport theory computer program was modified to calculate this new flux is described. It is concluded that the tilted flux is sensitive to boundary conditions. In particular, no generally satisfactory choice of boundary conditions in a cylindricalized cell was found. (auth)

32711 (AERE-NP/GEN-29) THE PHYSICS OF THE THERMAL NEUTRON SCATTERING LAW. P. A. Egelstaff (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1962. 42p.

The physical ideas that have led to an understanding of the scattering of thermal neutrons by condensed atomic systems are discussed. Starting from the neutron-nucleus interaction the physics is presented through to the details of the atomic motions, but no detailed theory is given. A new model for the motion of single atoms, which involves only one atomic constant, is discussed, and its value in neutron thermalization calculations is indicated.

The problem of resonance absorption line shape and its relation to resonance absorption integrals are considered. It is concluded that the neutron scattering and absorption theory is now sufficiently reliable to calculate the cross sections required initially for these problems and that improvements in methods of calculation and in reactor physics should go in step with improvements in basic data. (auth)

32712 (CEA-R-2329) ÉTUDE ET PRODUCTION DE FAISCEAUX MONOCHROMATIQUES POLARISÉS DE NEUTRONS LENTS. (Study and Production of Polarized Monochromatic Thermal Neutron Beams). Hans Beil (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 70p.

Thesis submitted to Université, Paris.

Results obtained with a recently built neutron spectrometer producing monochromatic polarized neutron beams in the energy range 10^{-3} to 10 ev, and using a series of artificial (Co-8% Fe) monocrystals as polarizers and analyzers, are given. A high-precision method for cutting monocrystals is explained. A description of the installation itself as well as some results obtained with Fe_3O_4 crystals are also given. Experimental results pertaining to various magnetic guide and "spin-flip" systems, as required in the handling of such polarized neutron beams, are also discussed. (auth)

32713 (CEA-R-2412) ETUDES DE MAGNETISME REALISEES A L'AIDE DE LA DIFFUSION INELASTIQUE DES NEUTRONS FROIDS. (Studies of Magnetism by Means of Inelastic Scattering of Cold Neutrons). Bernard Jacrot (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 126p.

Thesis submitted to Université, Paris.

Inelastic scattering of cold neutrons can be used to study some aspects of magnetism: spin waves, exchange integrals, vicinity of Curie point. After description of the experimental setup several experiments in these fields are analyzed. (auth)

32714 (CONF-446-7) A VARIATIONAL PROCEDURE FOR CALCULATING HIGH-ENERGY FEW-GROUP SPATIALLY DEPENDENT SPECTRA. P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.). [June 1964]. Contract W-31-109-eng-52. 14p.

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A fast method that provides the accuracy comparable to multigroup methods was developed for reactor calculations in the 10 Mev to 0.625 ev range. The energy range is divided into three discrete lethargy groups in which a different set of two overlapping spectra is used for each group. Results are compared with IBM 704 multigroup P1MG calculations. (R.E.U.)

32715 (KFKI-64-3) SCATTERING OF SLOW NEUTRONS BY MOLECULES. G. Kosály and G. Solt (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1964. 55p.

The general expressions for the slow-neutron scattering cross section are derived. The treatment emphasizes the way the spin and Pauli principle enter the problem. A review of the basic concepts of classical and quantum theory of molecular motion is given. The different approximate procedures applied for the calculation of slow-neutron scattering by molecules are reviewed. The large recoil character of the mass tensor approximation is stressed. (auth)

32716 SEMI-EMPIRICAL FORMULATION OF NEUTRONIC SPECTRA. J. P. Genthon. Bull. Inform. Sci. Tech. (Paris), No. 82, 39-46(Apr. 1964). (In French)

An advanced study of physical or physicochemical reactions brought about in reactors by the kinetic energy of neutrons calls for, in particular, a knowledge of the energy distribution of the neutron flux. An expression $\psi(E)$ for this distribution is proposed: $\psi(E) = K[\psi_0(E) + h\psi_e(E)]$, where E is the so-called homogeneous constituent that corresponds more or less to the case of an infinite homogeneous medium and $\psi(E)$ is the heterogeneous constituent of the flux. The expressions for $\psi_0(E)$ and $\psi_e(E)$, the parameters involved, as well as K and h, are on the one hand characteristic of the nature of the pile moderator, and on the other hand determined by a flux resonance measurement and one (or possibly two) measurement using a threshold detector. (auth)

32717 CALCULATION OF MIGRATION AREAS IN HETEROGENEOUS REACTORS WITH PERIODIC STRUCTURE. Ernst Behrens and Werner Oldekop (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 6: 120-7 (May 1964). (In German)

A general method is developed to establish the criticality condition and the flux shape in heterogeneous reactors with a periodic structure. By means of a consistent power series expansion of all quantities in terms of the geometrical bucklings, formulas are derived to determine k_∞ and the components of migration areas in the principal directions of the lattice. It is shown that the migration areas $M^2_{||}$ and $M^2_{\perp}$ are expressible by simple integrals over periodic functions which are obtained as solutions of cellular equations. Within the framework of diffusion theory, explicit formulas are derived for slab lattices and rectangular lattices. Comparison is made with the results of other authors and some simple examples are discussed. (auth)

32718 APPROXIMATION FORMULAS TO THE THEORY OF RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS STRUCTURES. Manfred Brose (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 6: 127-34(May 1964). (In German)

The known integrals of the "narrow resonance" approximations could be analytically explained by application of an approximation given by Roe for the Doppler-broadened effect cross section (ψ function) and of an approximation for the collision probabilities of plates and rod geometry. In some cases a comparison was made with the results of numerical integrations by Adler and Nordheim. (tr-auth)

32719 THE MEASUREMENT AND CALCULATION OF THE RESONANCE ABSORPTION OF NEUTRONS IN GOLD FOILS. Manfred Brose (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 6: 134-41(May 1964). (In German)

The measurement results of the resonance integrals of gold foils are given. Approximation formulas were developed which permitted a calculation of the resonance integrals in plate geometry. The formulas are applied to gold, and a comparison is made between experiment and theory. (tr-auth)

32720 ANALYTICAL METHOD FOR DETERMINING n-GROUP NEUTRON FLUXES IN CYLINDRICAL SHIELDING PROBLEMS USING LIE SERIES. F. Cap (Universität, Innsbruck, Austria) and J. Mennig. Nukleonik, 6: 141-7 (May 1964).

Calculation of fluxes in shields of cylindrical reactors by means of n-group diffusion theory illustrates the usefulness of Lie series in reactor theory. While it is possible

to use difference techniques to solve the problem in cylindrical geometry, computing times are relatively long. Analytical methods are faster, but lead to numerical difficulties for large arguments of the Bessel functions. By using Lie series, the combined flux and current vector in n-group theory may be written in the form $\vec{g}^{cylinder} = \vec{g}^{plane} - \vec{g}^{correction}$ for arbitrary arguments. Integration of the n-group diffusion equations by means of Lie series results in an explicit expression for $\vec{g}^{correction}$. The vectors are functions of $\xi_\mu = r - r_{\mu-1}$ only, where $r_{\mu-1}$ denotes the inside radius of the μ'th zone. This eliminates numerical difficulties associated with the evaluation of Bessel functions depending on r and $r_{\mu-1}$ separately when the arguments become large. Recursion relations permit calculation of an arbitrary number of terms in the Lie series and lead to solutions of any desired accuracy within the framework of diffusion theory. Separating out $\vec{g}^{plane}$ sults in rapid convergence and essentially reduces the cy lindrical problem to one in plane geometry which can be solved on a relatively small computer. (auth)

32721 A VARIATIONAL APPROACH TO THE TIME-DEPENDENT SLAB. R. Kladnik (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 6: 147-53(May 1964).

The asymptotic behavior of a neutron pulse injected into an infinite slab of finite thickness is discussed. For illustration, a monokinetic transport of neutrons with isotropic scattering was chosen. Two integrals of the transport equation and the variational method are used in order to obtain the dependence of the extrapolated end point upon the slab thickness. The extrapolated end point x_0 is obtained as the largest positive root of a given transcendental equation. It is suggested that the asymptotic mode may exist within the slab no matter how thin the slab is. The expression for the angular distribution of the leaking neutrons was improved by one iteration of the integral transport equation. The results show a characteristic angular peaking of the neutrons leaking from slabs of extremely small thicknesses. (auth)

32722 ON THE NUMERICAL SOLUTION OF THE NEUTRON TRANSPORT EQUATION. J. Lieberoth (Interatom, Bensberg, Ger.). Z. Angew. Math. Mech., 43: T18-20(1963). (In German)

The "packet method" for solution of the neutron transport equation was extended to spherical and cylindrical cells as well as to any large plane plate cell. (M.C.G.)

32723 ON THE MATHEMATICAL THEORY OF THE DIFFUSION OF NEUTRONS IN A SLOWING-DOWN MEDIUM. Antonio Pignedoli (Università, Bologna). Z. Angew. Math. Mech., 43: T23-31(1963). (In German)

The energy distribution of neutrons with energies smaller than 0.4 ev in a slowing-down medium was considered from the standpoint of the Fokker-Planck differential equation. Studies were made of the slowing down of thermal neutrons in paraffin. (M.C.G.)

Nuclear Properties and Reactions

Refer also to abstracts 32329, 32330, 32403, and 32453.

32724 (A/CONF.28/P/262) DEVELOPMENTS IN RESONANCE ABSORPTION. J. Chernick (Brookhaven National Lab., Upton, N. Y.) and M. M. Levine. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented on developments in resonance absorption of neutrons in reactors, which include refinements of the basic theoretical methods, extensions of calculational tools to more novel or complex problems, and integral experiments designed to test or improve aspects of the theory. The method of collision probabilities, equivalence theorems, the integral equation method, Monte Carlo methods, and resonance integral measurements are discussed. 100 references are included. (P.C.H.)

32725 (A/CONF.28/P/269) FISSION-PRODUCT BUILD-UP AND LONG-TERM REACTIVITY EFFECTS. Robert G. Nisle (Phillips Petroleum Co., Idaho Falls, Idaho), D. R. deBoisblanc, E. Fast, and J. C. Connor. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Experimental results on fission-product poisoning and long-term reactivity effects are reviewed. In particular, results are reported for irradiations of natural uranium, ^{235}U, and ^{233}U. Fission-product reactivity changes were examined as functions of cooling time in the range from 15 min to 7200 hr after exposure. It was concluded that experimental and theoretical results of studies on reactivity changes due to fuel irradiation and fission-product buildup agree within experimental uncertainties. This was found to hold for both long and short cooling times. The fission yield of the mass-135 chain for ^{233}U relative to ^{235}U was found to be 0.83 ± 0.06 and the relative primary yields of ^{135}I and ^{135}Xe were found to be the same for the two fissionable isotopes. (P.C.H.)

32726 (AERE-R-4649) THE CALCULATION OF NEUTRON CROSS SECTIONS FROM THE NON-LOCAL OPTICAL MODEL. D. Wilmore (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1964. 114p. (EANDC(UK)-36(U))

Neutron total and differential elastic scattering cross sections for Ca, Si, S, Ti, Fe, Ba, Pb, and U are calculated from an optical model derived from the nonlocal optical potential of Perey and Buck. It is shown that cross sections, which agree well with experiment, can be obtained with a potential that contains its own variation with energy and mass number. (auth)

32727 (BNL-846) AN EXTENDED TABLE OF NUCLIDIC MASSES. Manny Hillman (Brookhaven National Lab., Upton, N. Y.). Mar. 1964. Contract [AT(30-2)-Gen-16]. 143p.

About 7000 nuclidic masses for A = 1 to 255 were calculated based on parabolic systematics. The parabolic parameters, the masses, and energies available for emission of negatrons, positrons, neutrons, protons, and alpha particles are tabulated. The known nuclidic masses are compared with the calculated masses. (auth)

32728 (CEA-R-2416) CONTRIBUTION A L'ETUDE DES NIVEAUX EXCITES DU ^{12}C OBTENUS PAR LES REACTIONS $^{11}B(p,\alpha_0)$ ET $^{11}B(p,\alpha_1)$. (Contribution to the Study of ^{12}C Excited Levels Resulting From the Reactions $^{11}B(p,\alpha_0)$ and $^{11}B(p,\alpha_1)$). Jean-Pierre Longequeue (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 72p.

Thesis submitted to Université, Grenoble, France.

The differential cross sections were determined for the reactions $^{11}B(p,\alpha)$ from 130 to 500 kev, thus confirming, at the 163 kev resonance, the (2^+) characteristics of the 16.11-Mev level of ^{12}C. The experimental results in the neighborhood of the 163-kev resonance can be explained by the

interference of the ^{12}C levels: 2^+ at 16.11 Mev and 1^- at 17.23 Mev for the α_0, 2^+ at 16.11 Mev and 2^- at 16.58 Mev for the α_1. The (α-^{8}Be) disintegration process of ^{12}C was studied in the neighborhood of the 16.11-Mev level. It is shown that, if the (α-^{8}Be) mode of disintegration is preponderant outside the Ep = 163-kev resonance, it is also preponderant at this same resonance; a direct disintegration of the ^{12}C to 3 α, with an approximate magnitude of 40 per cent was, however, not excluded. (auth)

32729 (CONF-481-70) CREATION OF HEAVY NUCLIDES WITH THE AID OF NUCLEAR EXPLOSIONS. J. Carson Mark (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 21p.

From American Physical Society Annual Meeting, New York, Jan. 1964.

The production of nuclei of A > 238 in underground nuclear explosions is discussed, and, in particular, nuclei of A > 257 are considered. (R.E.U.)

32730 (EANDC(OR)-31(L)) MEASUREMENT OF PROMPT $\bar{\nu}$ IN FAST NEUTRON FISSION OF U^{238} INDUCED BY NEUTRONS FROM 1.5 TO 15 Mev. I. Asplund-Nilsson, H. Condé, and N. Starfelt (Sweden. Försvarets Forskningsanstalt, Stockholm). Apr. 1964. 26p.

The average number of prompt neutrons, $\bar{\nu}$, emitted per fission was measured for the neutron induced fission of ^{238}U. The measurement was made for several incident neutron energies between 1.5 and 7.5 Mev and for 14.8 Mev. A large liquid scintillator was used as the detector of the fission neutrons. The experimental results can be represented above the threshold for fission by a linear relationship $\bar{\nu}(E) = 2.284 + 0.152E$. The results are also in good agreement with the "universal $\bar{\nu}$-curve" of Hopkins and Diven. An attempt to investigate the possibility of a step at 6 Mev in the $\bar{\nu}$ versus neutron energy curve was also made. (auth)

32731 (ISS-64/5) ANALISI CINEMATICA DI EVENTI DI FOTOPRODUZIONE DOPPIA CARICA IN CAMERA A DIFFUSIONE. (Kinematic Analysis of Double-Charged Photoproduction Events in a Diffusion Chamber). U. Amaldi, Jr., G. Campos Venuti, and G. Matthiae (Italy. Istituto Superiore di Sanita, Rome). Mar. 5, 1964. 37p.

During the preparation of an experiment to study the process of double photoproduction ($\gamma + p \rightarrow p + \pi^+ + \pi^-$) in a diffusion chamber, two methods for the kinematic reconstruction of events were worked out. The first method was also utilized in the preparation of a program of spatial reconstruction for the IBM 7040. (auth)

32732 (ISS-64/8) APPLICAZIONE DEL METODO DI MONTECARLO ALLA SCELTA DELLE CONDIZIONI SPERIMENTALI PER LO STUDIO DI REAZIONI (e,e'p). (Application of the Monte Carlo Method to the Choice of Experimental Conditions to Study the Reactions (e,e'p)). U. Amaldi, Jr., and G. Fronterotta (Italy. Istituto Superiore di Sanita, Rome). Mar. 20, 1964. 29p.

At the Frascati Electron Synchrotron an experiment is now in progress to study the reactions (e,e'p) on nuclei. The choice of experimental conditions is analyzed. The analysis is based on the impulse approximation and the Monte Carlo Method. After the general treatment of the problem the flow chart of the Fortran IV program written for this purpose and the results obtained for s and p protons of ^{12}C are presented. (auth)

32733 (ISS-64/10) ASSORBIMENTO DI MESONI π^- IN Cu, Sn E Pb. (Negative Pion Absorption in Cu, Sn, and Pb). G. Campos Venuti, G. Fronterotta, and G. Matthiae (Italy. Istituto Superiore di Sanita, Rome). Apr. 3, 1964. 27p.

An experiment performed at the Electron Synchrotron in Frascati is described for measuring the energy spectrum of neutrons emitted at 1 to 50 Mev in the capture of negative pions at rest in complex nuclei. The experimental data obtained using targets of Cu, Sn, and Pb are presented and discussed. Each of the energy spectra of neutrons emitted is characterized by a low-energy evaporation part with a maximum at about 2 to 3 Mev. Comparison of data obtained in π^- absorption in the almost double magic nucleus of Pb, with results of other experiments using the same excitation energies, shows shell-model effects on evaporation processes. (auth)

32734 (KFKI-14/1963) DIRECT EFFECT IN (p,γ) REACTIONS. Ilona Fodor, I. Berkes, I. Demeter, I. Dézsi, and L. Keszthelyi (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1963. 14p. (N64-15987)

The $^{11}B(p,\gamma)^{12}C$ reaction was studied, and a number of experiments at the resonance level of E_p = 163 kev of bombarding proton energy were conducted. (R.E.U.)

32735 (LAL-1108) GENERAL TECHNIQUE OF QUASI-ELASTIC SPECTRUM STUDY–APPLICATION TO Be^9. Hoan Nguyen Ngoc and Jean P. Perez Y Jorba (Paris. Universite, Orsay. Ecole Normale Superieure. Laboratoire de l'Accelerateur Lineaire). June 1964. 65p.

A formula that allows the extraction of the nuclear cross sections from experimental quasielastic electron-scattering spectra was developed. Tests were carried out to prove the consistency of the techniques. In particular, it is proved that a hitherto unmeasured cross section can be calculated from a limited number of experimental data. These techniques were applied to ^9Be. Interpretations of the extracted cross sections were estimated on three models. (auth)

32736 (NP-14092) SVOISTVA VOZBUZHDENNYKH SOSTOYANII YADER F^{19}, Na^{21}, Na^{23}, Al^{25}, Al^{26}, Al^{27}, I P^{31} IZ DANNYKH PO RASSEYANIYU PROTONOV. (The Properties of Excited States of Fluorine-19, Sodium-21, Sodium-23, Aluminum-25, Aluminum-26, Aluminum-27, and Phosphorus-31 from Data on Proton Scattering (thesis)). V. E. Storizhko (Akademiya Nauk Ukr. S.S.R. Fizikko-Tekhnicheskii Institut). 1964. 110p.

A review is given of the structure of nuclei with A between 16 and 40 and of the use of proton scattering by nuclei as a source of spectrometric information. The theory of resonance scattering of protons by nuclei is considered. Methods of data analysis for elastic and inelastic scattering are described. Experimental procedures, the charged-particle magnetic spectrometer, and the gas targets are discussed. Results of measurements of cross sections, angular distributions, and energy levels are presented in detail for ^{19}F, ^{21}Na, ^{22}Na, ^{25-7}Al, and ^{31}P. The statistical properties of the nuclear levels are considered, and an interpretation is given of the levels of ^{28}Al on the basis of the shell model. (M.J.T.)

32737 (NP-14094) O TYAZHELYKH IZOTOPAKH VODORODA I NEITRONA. (The Heavy Hydrogen Isotopes and Neutrons). N. A. Vlasov and L. N. Samoilov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 18p.

Data on 4 and 5 nucleon nuclei confirmed the existence of unbound excited states for ^4He at 20.1 Mev, 0^+, T = 0; 22 Mev, 2^-, T = 0; and 24 to 25 Mev, 1^-, T = 1. The corresponding isobar nuclei ^4H and ^4Li are in bound states

with half lives of 10^{-22} sec. The ^{5}H nucleus is in an unbound state with a ^{3}H + 2n decay energy of $Q \geq 2$ Mev and a lifetime of 10^{-22} sec. Previous data on ^{5}H were not verified. An analysis of nuclear bond energies indicated the absence of the tetraneutron. The ^{4}H, ^{5}H, and ^{4}n and other heavier hydrogen and neutron isotopes are unstable and decay with nucleon emission. (tr-auth)

32738 (PWAC-433) THE INTEGRAL $Be^{9}(n,2n)$ CROSS SECTION. F. F. Felber, Jr., D. R. Farmelo, and V. C. Van Sickle (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 19, 1964. Contract AT(30-1)-2789. 28p.

The integral $^{9}Be(n,2n)$ cross section was determined on beryllium and BeO specimens irradiated in the core of the Battelle Research Reactor. The value obtained was 460 ± 60 millibarns, above 2.7 Mev in a fission spectrum. Fast neutron dosimetry was accomplished using iron, nickel, and titanium threshold detectors. The results are based on measurement of the total amount of helium produced during irradiation. Corrections were made for the small contribution from (n,α) reactions on ^{9}Be and ^{16}O. (auth)

32739 (TID-18567) STUDY OF COMPLEX BETA DECAY SPECTRA. Report No. 5. Final Report, October 1, 1956–September 30, 1961. M. H. Kurbatov and J. D. Kurbatov (Ohio State Univ. Research Foundation, Columbus). Jan. 1963. Contract AT(11-1)-469. 130p.

Includes Appendices I through VI.

Separate abstracts were prepared for two sections on carrier-free chemical procedures and complex beta decay and for six appendices. The report represents a final analysis of work done during 1956–61; appendices include details of work during 1961. (R.E.U.)

For abstracts of individual sections see: 31566, 31567, 31568, 31915, 32740, 32741, 32742, and 32743.

32740 (TID-18567(p.7-48)) COMPLEX BETA DECAY. (Ohio State Univ. Research Foundation, Columbus).

A study of the complex beta decay spectra of ^{56}Co, ^{59}Fe, ^{76}As, ^{76}Br, ^{77}Br, ^{99}Rh, ^{101}Rh, and ^{102}Rh is presented. (R.E.U.)

32741 (TID-18567(App.I)) DECAY OF ARSENIC-76. H. John Sathoff, T. Hayashi, J. R. Comerford, Jr., M. H. Kurbatov, and J. D. Kurbatov (Ohio State Univ. Research Foundation, Columbus). 28p.

Beta and gamma spectra from the decay of ^{76}As were measured by scintillation methods. Spin assignments were made based on angular correlation studies. An improved ^{76}Se energy level scheme is presented. (R.E.U.)

32742 (TID-18567(App.II)) EXPERIMENTAL DATA ON EMISSION OF POSITRONS AND GAMMA RAYS IN THE DECAY OF BROMINE-76. J. R. Comerford, Jr., H. John Sathoff, T. Hayashi, M. H. Kurbatov, and J. D. Kurbatov (Ohio State Univ. Research Foundation, Columbus). 19p.

The spectra from the electron-capture and positron-emission decay of ^{76}Br was studied. Sample preparation and beta measurements using a magnetic spectrometer and a coincidence spectrometer are discussed. Selenium-76 energy levels were studied, and spin assignments are given. (R.E.U.)

32743 (TID-18567(App.IV)) DIRECTIONAL CORRELATION OF GAMMA RAYS OF BROMINE-77. T. Hayashi and J. D. Kurbatov (Ohio State Univ. Research Foundation, Columbus). 8p.

Energy levels of ^{77}Br were studied from angular correlations of gamma rays emitted from the first eight excited states. (R.E.U.)

32744 (UCRL-7648) THE SCATTERING OF PROTONS BY O^{18} (thesis). Jack Stevens (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 20, 1964. Contract W-7405-eng-48. 119p.

The scattering of protons by ^{18}O in the energy range of 7.89 to 16.28 Mev was studied; 11 angular distributions were obtained for elastically scattered protons, for protons leaving ^{18}O in its first excited state, and for alpha particles from the reaction $^{18}O(p,\alpha)^{15}N$. In addition excitation functions were obtained at five angles; these angles included the zeros of the first four Legendre polynomials. A strong resonance is exhibited in both the elastic and inelastic scattering at about 10.5 Mev. Calculations made with an optical model using a Saxon-Woods real potential and a Gaussian imaginary potential plus a spin-orbit term compare very well with experiment; however, the parameters obtained are not a smooth function of the energy. Distorted-wave Born approximation calculations of the inelastic scattering compare reasonably with the experiment and lead to an estimate of the nuclear deformation β. (auth)

32745 (UCRL-11213(p.1-48)) RADIOACTIVITY AND NUCLEAR STRUCTURE. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Lifetimes, energy levels, and other parameters were studied for the following isotopes: ^{249}Bk, ^{131}Cs, ^{143}Pr, ^{254}Es. At isotopes, ^{255}Fm, ^{229}Pa, ^{223}Ac, ^{153}Gd, ^{148}Pm, ^{131}Sb, ^{208}Tl, and ^{208}Bi. Other topics studied were nuclear spectroscopy, mixed transitions, odd and even nuclei, spherical nuclei, nuclear deformation, etc. (D.L.C.)

32746 (UCRL-11213(p.49-63)) FISSION. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Gamma-ray spectra from spontaneous fission of ^{252}Cf were studied, and well-defined prompt γ-ray peaks were found by means of association with various values of the mass ratio and the Doppler shift. Improvements in the Hilac heavy-ion linear accelerator are described which should increase the duty factor. The ratios of ^{115m}Cd to ^{115g}Cd produced in heavy-ion-induced fission of ^{197}Au and ^{238}U were measured using ^{16}O and ^{12}C ions and correcting for ^{115}Ag decay. Fission fragment kinetic energy measurements were made for the alpha-induced fission of several isotopes. The results for ^{209}Bi + 65.0-Mev α are compared with theoretical contour maps, and mass profiles are given for ^{232}Th for three different total kinetic energies and alpha bombardment energies. Energy and mass distributions of fission fragments were measured for the ^{16}O-induced fission of ^{182}W, and the results are compared with those predicted by the liquid drop model for the ^{198}Pb compound nucleus. Fission barriers were determined for the compound nuclei ^{201}Tl and ^{198}Hg produced by the bombardment of ^{197}Au by ^{4}He and protons, respectively. (D.L.C.)

32747 (UCRL-11213(p.64-86)) NUCLEAR REACTIONS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Measurements of the proton polarization produced in the elastic scattering of 22-Mev protons by deuterons were made which show substantial polarization. In an optical-model analysis of 48-Mev alpha particles scattered by ^{12}C, real and imaginary potentials were derived for several sets of parameters that gave good fits to the elastic scattering data. Energy spectra and angular distributions were measured for the reactions $^{16}O(p,t)^{14}O$ and $^{16}O(p,^{3}He)^{14}N$ at 43.7 Mev. The elastic and inelastic scattering of 65-Mev helium ions by ^{16}O and the resulting excited levels of ^{16}O were studied. The strong formation

of high-spin levels in several (α,d) reactions was studied. Results are summarized for calculations of μ capture transition rates in ^{12}C and ^{16}O. Differential cross sections and angular distributions were measured for the elastic and inelastic scattering of 64.3-Mev alpha particles by ^{58}Ni and ^{58}Fe. Alpha scattering by ^{63}Cu and ^{62}Ni were used to study the excited energy levels of these nuclei. The range and range straggling of recoil Tb and Dy, produced by heavy-ion-induced reactions, in gases and Al were studied, and the anisotropy and neutron and photon energies for ^{149}Tb were determined. Excitation functions are presented for (^3He,^7Be) and (^4He,^7Be) reactions of ^{27}Al and ^{12}C. The excitation function of the $^{12}C(\pi^-,\pi^-n)$ reaction was also measured at 53 to 1610 Mev. (D.L.C.)

32748 (UCRL-11373) A CONTRIBUTION TO THE QUASI-PARTICLE DESCRIPTION OF SPHERICAL NUCLEI. Mannque Rho (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1964. Contract W-7405-eng-48. 8p. (CONF-502-16)

From International Congress of Nuclear Physics, Paris, July 1964.

A central force with only the singlet component is used to solve the BCS-Baranger equations for some single-closed 82-neutron nuclei, and the resulting wave functions are in turn used to calculate some excited levels of even-even nuclei. The roles of the quasiparticle residual terms are studied and within Tamm-Dancoff approximation (TDA) certain conditions are found to be necessary for the theory to agree with the experimental trends of the energy spectra, the enhanced $2^+ \rightarrow 0^+$ ground state and retarded $4^+ \rightarrow 2^+$ transitions. For the quasiparticle interactions in TDA, a triplet force as strong as the singlet seems to be needed. A rough estimate of the lowest-order ground-state correlation is made for the enhanced $2^+ \rightarrow 0^+$ transition, and the contribution appears to be negligible. (auth)

32749 (UCRL-11378) SEARCH FOR CORE-EXCITED STATES IN N^{15}. B. G. Harvey, J. R. Meriwether, A. Bussiere de Nercy (California. Univ., Berkeley. Lawrence Radiation Lab.), and D. J. Horen (Naval Radiological Defense Lab., San Francisco). Apr. 1964. Contract W-7405-eng-48. 7p. (CONF-502-15)

From International Congress of Nuclear Physics, Paris, July 1964.

Differential cross sections for the scattering of 40.2-Mev alpha particles by ^{15}N and ^{16}O were measured. The elastic cross section for ^{15}N contains a deep minimum at about 88 degrees in the center-of-mass system, analogous to that previously reported for the scattering of 41-Mev alpha particles by ^{16}O. Alpha groups that correspond to excitation of levels in ^{15}N at 5.276, 6.328, 7.16, 7.31, and 7.57 Mev (as well as others) were observed, and their angular distributions determined. Preliminary analysis of the data indicates that the levels at 5.276 and 7.57 Mev are formed by the coupling of the odd $p_{\frac{1}{2}}$ nucleon to a core excitation whose description is similar to that which gives rise to the 6.13-Mev level (3-) in ^{16}O. Analogously, the 7.31-Mev level in ^{15}N appears to be formed by the coupling of the $p_{\frac{1}{2}}$ nucleon to a core excitation whose description is similar to that which gives rise to the 7.12-Mev level (1-) in ^{16}O. (auth)

32750 (USNRDL-TR-742) EVIDENCE AGAINST A WEAK COUPLING MODEL FOR ^{57}Fe. C. S. Cook (Naval Radiological Defense Lab., San Francisco). May 12, 1964. 8p. (AD-601625)

A number of nuclear models have been explored during recent years in attempting to explain the energy levels of the nuclide ^{57}Fe but none of these can be fitted to the experimental data with really significant precision. Another possible nuclear model, in which the low-lying excited energy levels are formed from coupling the last odd neutron of ^{57}Fe to the quadrupole vibrational state of the remaining core of nucleons, a core-excited state model, is discussed in this paper. Although some aspects of the physical properties of ^{57}Fe appear to fit such a model, the relative number of such agreements is not significantly greater than for other models. (auth)

32751 (WASH-1048) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, COLUMBIA UNIVERSITY, JUNE 4-5, 1964. A. B. Smith, comp. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 140p. (EANDC(US)-57"U")

A collection of reports that were presented to the AEC Nuclear Cross Sections Advisory Group for consideration is given. These reports contain an informal statement of recent developments, changes of emphasis, and preliminary data that are of importance to the cross section measurement program of the AEC. They are not intended to be complete and formal reports, nor do they cover all of the work of the laboratories relating to nuclear cross section measurements. In addition to the topical reports, a list of 73 pertinent publications is included. (auth)

32752 THE EFFECT OF RECOIL ON THE ANGULAR CORRELATION BETWEEN FISSION FRAGMENTS AND CHARGED PARTICLES EMITTED BY THE FISSIONING OF THE URANIUM NUCLEUS. Yu. F. Gagarin and V. I. Ostroumov. At. Energ. (USSR), 16: 296-300(Apr. 1964). (In Russian)

One of the authors et al. (Zhur. Eksper. i Teoret. Fiz., 33: 1335(1957); NSA 12: 6364) investigated the angular correlation between fragments and charged particles emitted by the high-energy-particle-induced fission of U and found that the correlation was more definite for α-particles than for protons. This was attributed to the recoil effect resulting from the evaporation of the charged particles. The problem of the evaporation of neutrons and charged particles and the recoil was further investigated by means of a fine-grain, low-sensitivity nuclear emulsion containing U. The irradiation was carried out in the 600-Mev proton beam of the Joint Institute's synchrocyclotron. The geometry of the experiment tended to minimize the disturbing effect due to the direction of the cascade particles. Altogether, 1368 fission events were recorded, containing 2258 protons, 719 α-particles, 26 particles with a change of $Z \geq 3$, and 61 unidentified particles. The ratio of the α-particles emitted in the forward direction with respect to the incident proton beam to those emitted backward was 1.22, indicating that cascade α-particles were present. It was found that about 56% of the α-particles and 52% of the protons were directed toward the heavy fragment; this effect was found to increase in the case of asymmetric fission. This may be explained by the recoil effect originating at the evaporation of the charged particles, if it is assumed that the predominant amounts of the α-particles and of the protons were evaporated before the fission events. If the recoil effect is taken into account, the angular distribution of the charged particles in the fission system becomes isotropic. (TTT)

32753 CALCULATION OF THE EXCITATION ENERGY OF FISSION FRAGMENTS. G. I. Babkin. At. Energ. (USSR), 16: 300-4(Apr. 1964). (In Russian)

In order to be able to estimate the number of the secondary fission neutrons, the excitation energy of the frag-

ment nuclei must be known. This problem has been examined previously by means of the liquid drop model; it is further studied for the limiting case in which the friction forces may be neglected. In the calculation of the fission neutron spectrum, it was assumed that they are emitted isotropically by moving fragments in their center-of-mass system; previous calculations indicated that the emission occurs within 10^{-20} to 10^{-14} sec, at which time the neutrons reach their maximum energy. The calculations were carried out with nuclei for which the mass distribution of the fragments was known; assuming that the mass and charge distributions are similar for both the spontaneous and threshold fissions. The energy gain in the case of asymmetric fission, the excitation energy of the fragments at the time of the breaking up of the system, and the supplementary excitation energy of the emitted fragments were calculated; the latter value was found to be about 1 Mev. Formulas were derived for calculating the number of secondary neutrons; the figures obtained were found to agree well with the experimentally determined data and with the averages reported by I. I. Bondarenko et al. (NSA 13: 7013). (TTT)

32754 NOMOGRAMS FOR CALCULATING THE KINEMATIC ELEMENTS OF NUCLEAR REACTIONS YIELDING TWO PARTICLES. G. N. Potetyunko. At. Energ. (USSR), 16: 349-51(Apr. 1964). (In Russian)

In a previous study (Atomnaya Energ. 13: 588(1962); NSA 17: 13493), a nomogram was presented for determining the correlation between angles of the products emitted by a nuclear reaction. However, the mathematical transformations needed for the construction of practically useful nomograms required extensive computations and therefore, it was attempted to simplify the process. On the basis of several simplifying assumptions, a nomogram consisting of straight-line and hyperbolic scales was constructed. The answer sought may be obtained by the intersection of a straight line connecting the given points, with the third scale. The equation used contains the third nomographic order expression. By employing further geometric simplifications, a circular nomogram may be obtained. (TTT)

32755 THE PROBABILITY OF THE DELAYED-NEUTRON EMISSION BY HALIDES. P. M. Aron, O. I. Kostochkin, K. A. Petrzhak, and V. I. Shpakov. At. Energ. (USSR), 16: 368-70(Apr. 1964). (In Russian)

The probability of the delayed-neutron emission by ^{87}Br during the fissioning of ^{235}U was determined on the basis of the ratio of the yield of a first group of delayed neutrons with a half-life of 56 seconds and the radiochemically determined ^{87}Br yield; however, the ^{86}Br was not separated during these measurements. An attempt was therefore made to determine the probability of the delayed-neutron emission by the precursors of ^{87}Br, ^{88}Br, ^{89}Br, ^{137}I, and ^{138}I while fissioning ^{238}U and ^{232}Th with 14-Mev neutrons, separating the Br or I from the other fission products by chemical methods. The absolute neutron and β-activity of these elements was measured, determining the activity of the individual isotopes by analyzing their decay curves. The probability of the delayed-neutron emission was derived from the ratio of the neutron and β-activities of identical amounts of the isotope in question. The neutron activity of Br and I included barely one half-life. The β-decay curve of Br contained the following half-lives: 56 seconds (^{87}Br and ^{86}Br); 3 minutes (^{88}Br); 31 minutes (^{84}Br); 75 minutes, (^{87}Kr daughter), and also 6.3 and 20 minutes (^{78}Br and ^{80}Br), resulting from the activation of the Br carrier by the (n,2n) reaction. The decay curve of I included the following half-lives: 24 seconds (^{137}I), 86 sec (^{136}I), 3.9 minutes (^{137}Xe daughter), It was concluded that the delayed neutron emission probability does not depend on the isotope, the fission of which created the precursor. (TTT)

32756 RADIOCHEMICAL DETERMINATION OF THE ^{27}Al(n,α)^{24}Na REACTION AT A NEUTRON ENERGY OF 14.6 Mev. P. M. Aron, S. S. Bugorkov, K. A. Petrzhak, and A. V. Sorokina. At. Energ. (USSR), 16: 370-2(Apr. 1964). (In Russian)

The cross section data of the ^{27}Al(n,α)^{24}Na reaction for 14.6-Mev neutrons reported in the literature are contradictory; the previous measurements were made without separating the ^{24}Na by radiochemical methods. An attempt was made to determine the cross section of this reaction by separating quantitatively the ^{24}Na without a carrier from the irradiated Al target material and checking the radiochemical purity of the separated ^{24}Na by its half life. A low-voltage neutron generator, operating on the basis of the T(n,d)^{4}He reaction, with 124-kev deuterons falling at an angle of 45° on a Ti–Mo target served as the neutron source. The Al discs were placed at 54.6 or 27.8 mm from the T targets, the neutron flux being determined through the specimens by the α-count at an angle of 135° with respect to the neutron beam. The value of the reaction cross section was σ = (106 ± 2.3) millibarn; the error listed corresponds to the mean square error. The constancy of the neutron flux was continuously controlled, dividing the 3- to 6-hour long irradiation periods,into shorter intervals, during which the flux changed less than ±5%. (TTT)

32757 EXPERIMENTAL APPARATUS FOR THE STUDY OF THE (γ,tn) REACTIONS NEAR THE TURIN C.S.F.B. 31-Mev BETATRON. G. Baciu (Inst. of Atomic Physics, Bucharest), B. Minetti, C. Molino, L. Pasqualini, and G. Piragino. Atti. Acad. Sci. Torino, Pt. I, Classe Sci. Fis., Mat. Nat., 98: 531-6(1963-64). (In Italian)

The experimental apparatus and the techniques used for the study of (γ,tn) reactions near the 31-Mev betatron of the Centro Studi Fisico-Biologici of Turin are described. The energy control system designed for this betatron is discussed. The results obtained in the study of the reaction ^{16}O(γ,tn) are given. (tr-auth)

32758 RADII, SURFACE DIFFUSENESS, AND BINDING ENERGIES OF ATOMIC NUCLEI. Jenn-lin Hwang and Yah-shian Yang (National Taiwan Univ.). Chinese J. Phys. (Taiwan), 2: 32-41(Apr. 1964).

In an effort to find a theoretical basis for previously proposed rules for calculating nuclear radii, the procedure of Green is reversed to determine a family of nuclear potentials. These potentials have flat bases and exponential tails. The radius of the inner region and the surface diffuseness of the potential are determined for the entire range of mass numbers A from the nuclear radii predicted by the proposed rules. The depth is then adjusted to give the correct trends of binding energies of the last nucleons. To test the depth and the diffuseness thus determined, the locations of the 3s and 4s maxima in the neutron cross section are determined and compared with the experimental data for the s-wave strength function. For proton potentials, the 3s maximum is at A = 55 and the 4s maximum at A = 162, in agreement with the prediction of most theories using spherical nuclei. (auth)

32759 ROTATION BAND K = 0 IN THE DECAY OF HAFNIUM-170. Jacqueline Treherne, Jacques Valentin, and Jean-Marie Van Horenbeeck (Laboratoire Joliot-

Curie, Orsay, France). Compt. Rend., 258: 5203-5 (May 25, 1964). (In French)

A rotation band K = 0 was shown in the odd-odd nuclear levels of ^{170}Lu. It results from the coupling of the seventy-first spin proton $^{7}/_{2}$ + (404) and the ninety-ninth spin neutron $^{7}/_{2}$ + (633). (tr-auth)

32760 DETERMINATION OF THE HALF-LIVES OF YTTERBIUM 165 AND 164. Pierre Paris. Compt. Rend., 258: 5855-6(June 15, 1964). (In French)

The half lives of ^{165}Yb and ^{164}Yb were determined. A value $T_{½}$ = 10.5 ± 0.5 min was obtained for ^{165}Yb, much lower than the generally accepted half life. The half life value for ^{164}Yb ($T_{½}$ = 78 ± 2 min) is in agreement with the accepted value. (J.S.R.)

32761 ISOTOPIC EFFECTS IN THORIUM SPECTRA. E. A. Vernyi and V. N. Egorov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 60-2(1962). (In Russian)

The spectra of an isotopic mixture of ^{229}Th and ^{232}Th were investigated by means of a diffraction spectrograph with a dispersion of 3.4 Å/mm. The isotopic shift was measured for 247 lines of Th II and Th I. The absolute value of the deformation coefficient was obtained for ^{229}Th and ^{232}Th relative to ^{230}Th. (C.E.S.)

32762 ISOTOPIC EFFECTS IN DYSPROSIUM SPECTRA. A. F. Golovin, Yu. P. Dontsov, and A. R. Striganov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatgo] Soveshch. Leningrad, 1960, 1: 62-5(1962). (In Russian)

The isotopic shift of the components ^{164}Dy, ^{162}Dy, and ^{160}Dy was measured in the spectral region of 4000 to 6600 Å to determine the nuclear quadrupole moment of ^{160}Dy. (C.E.S.)

32763 ISOTOPIC EFFECT IN SAMARIUM SPECTRA. V. A. Katulin and A. R. Striganov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 65-7(1962). (In Russian)

The spectra of natural and enriched samarium in the oxide Sm_2O_3 were investigated to determine the shift between the even-even isotopes ^{144}Sm, ^{148}Sm, ^{150}Sm, ^{152}Sm, and ^{154}Sm. (C.E.S.)

32764 HYPERFINE STRUCTURE OF ^{239}Pu SPECTRA. L. A. Korostyleva. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 69-72(1962). (In Russian)

The hyperfine structure in the spectra of ^{239}Pu was investigated by means of a Fabry-Pirot interferometer and a spectrograph. The wavelength and theoretical and experimental intensities of the hyperfine structure lines and the total angular momentum of the divided level are given. (C.E.S.)

32765 MAGNETIC MOMENTS IN ^{233}U AND ^{235}U NUCLEI. N. M. Yashin. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 74-6(1962). (In Russian)

The hyperfine structure of ^{233}U and ^{235}U was investigated. Equations to determine the magnetic moments of ^{233}U and ^{235}U were developed in terms of the wave numbers of the hyperfine structure lines, magnetic quantum numbers, total angular momentum quantum numbers, and nuclear spin. (C.E.S.)

32766 ON THE PRESENT STATUS OF THE PHENOMENALISTIC NUCLEAR THEORY. Kiyomi Ikeda (Nihon Univ., Japan) and Hiroshi Noya. Genshikaku Kenkyu, 8: 277-339(Aug. 1963). (In Japanese)

The phenomenalistic nuclear theory is now in the process of quantification, where the theory and experiment are inseparable. Described are the reports at the meeting held at Nihon Univ. last summer by the younger researchers from all over the country with the aim of developing in this field a closer linkage between theory and experiment. The article consists of five sections: 1) particle level and average potential, 2) residual interaction of the shell model, 3) effective interaction of many-particle correlation, 4) DWBA in the process of direct reaction, and 5) (d,p) reaction. In the first section it is emphasized that the concept of a mono-particle level, which was at first only a hypothetical one in the shell model, seems to have been raised to a substantial one and such a substantial concept should be introduced into the shell model. Further, making up of a self-consistent field from two-body nuclear force and its comparison with the average potential are suggested as problems. In the second section, methods of dealing with residual interaction to nuclei comparatively near closing and numerical values in practical use are described. In the third section, it is concluded that it is necessary to analyze the dimensions of effective interaction matrix elements, to pick up more complicated many-body correlations and to get more knowledge from presently unknown new phenomena. In the fourth section, analysis of DWBA in inelastic scattering and the (d,p) reaction with a high speed computer is outlined and analysis of experiments of (d,d′) and nuclei with odd mass number are pointed out as future problems. In the fifth section, analysis of momentum correlation (d,p) polarization and (d,pγ), analysis using finite range interaction, mixed momentum transfer and configuration mixing effect, and calculation of heavy particle stripping are shown as interesting problems in analysis of DWBA in (d,p) reaction. (NSA of Japan)

32767 MODIFIED SEMIEMPIRICAL MASS FORMULA FOR DIFFUSE NUCLEAR SURFACE. V. B. Bhanot, S. C. Gupta, and Santosh Kumar (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 2: 216-18(July 1964).

An attempt is made to modify Von Weizsäcker's semi-empirical mass formula by deriving new expressions for Coulomb, volume, and surface energy terms. A density distribution, which agrees better with the experimental results than the trapezoidal model, is proposed for deriving the new expressions. The density distribution is characterized by a central core of constant density and a skin thickness in which the mass and charge are assumed to drop to zero in three linear steps. (auth)

32768 NUCLEAR MAGNETIC RESONANCE FLUORINE–FLUORINE COUPLING CONSTANTS. Soon Ng and C. H. Sederholm (Univ. of California, Berkeley). J. Chem. Phys., 40: 2090-4(Apr. 15, 1964). (UCRL-11093)

The pattern of fluorine–fluorine coupling constants is explained on the basis of two mechanisms for nuclear spin–spin coupling: the through-bond and the through-space mechanisms. In the former, the interaction proceeds via the electronic structure in the intervening bonds. It is highly dependent on the electron withdrawing power of the substituents on the carbon skeleton. This contribution to the coupling constant goes to zero when the sum of the electronegativities of the substituents becomes sufficiently high. The latter mechanism is operative when two fluorine atoms are sufficiently close in space for there to be appreciable overlap of their electronic clouds. This through-space interaction proceeds via an electronic structure where there is no bond per se. Experimental evidence for the existence of both mechanisms is given. (auth)

32769 THE FISSION NUCLIDE, 1.6 MIN ^{104}Mo. G. P. Tercho and J. A. Marinsky (State Univ. of New York, Buffalo). J. Inorg. Nucl. Chem., 26: 1129-38(July 1964).

The 1.6 ± 0.1 min Mo that is produced in the fission of ^{235}U has, on the basis of its fission yield of 2.0 ± 0.3% and the absence of 4.5 hr ^{105}Ru as a decay product, been assigned a mass of 104. Its decay is characterized by the emission of at least two beta particles of 4.8 ± 0.3 and 2.2 ± 0.1 Mev maximum energy, respectively and a 70 ± 2 kev γ ray. There is evidence also for more penetrating γ radiation. (auth)

32770 STUDY OF THE DECAY ^{194}Hg → ^{194}Au. L. Bellanger, P. Kilcher, and N. Poffe (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). J. Phys. (Paris), 25: 303-4(Mar. 1964). (In French)

The disintegration of ^{194}Hg was studied by alpha and beta spectroscopy. The half life was found to be 700 ± 100 days. No beta or gamma rays were detected with energies of 20 to 80 kev, the upper limit of the transition energy being 83 kev. The disintegration was found to occur by L capture. The branching ratio through a possible isomeric ^{194}Au state was established to be <1%. (auth)

32771 SPECTRUM SHAPE FOR THE 965-kev BETA TRANSITION IN ^{198}Au. J. Lehmann (Centre d'Etude de l'Energie Nucleaire, Mol-Donk, Belg.). J. Phys. (Paris), 25: 326-8(Mar. 1964). (In French)

The beta spectrum for the $2^- \rightarrow 2^+$ transition was measured using an intermediate-range beta spectrometer. The form factor for the transition was determined and compared with other determinations. Only one value was incompatible with the present result. (D.C.W.)

32772 STUDY OF THE MECHANISM OF THE REACTIONS (d,p) AT LOW ENERGY. INTERFERENCE BETWEEN THE PROCESSES OF STRIPPING AND COMPOUND NUCLEUS FORMATION. P. Kossanyi-Demay and G. R. Bishop (Ecole Normale Superieure, Orsay, France). J. Phys. (Paris), 25: 329-36(Mar. 1964). (In French)

The excitation functions for (d,p) reactions on ^{24}Mg, ^{26}Mg, ^{32}S, and ^{35}Cl were measured between 1 and 2 Mev. At certain energies, the cross sections present resonances showing the formation of an intermediate compound nucleus. Proton angular distributions measured at these energies were symmetrical and were analyzed by the least squares method. Away from the resonances, asymmetrical angular distributions characteristic of stripping were observed. The stripping cross section for the ^{24}Mg(d,p)^{25}Mg reaction was calculated, taking into account the Coulomb interaction and proton scattering by the residual nucleus. The angular distributions obtained are in good agreement with the experimental data. The reduced widths of neutron capture for several energy levels were also calculated, and spins and parities were assigned to some excited states of the intermediate nuclei. (D.C.W.)

32773 ISOTOPIC EFFECTS IN THE INTERACTION OF BETA PARTICLES WITH MATTER. Jean-Jacques Point and Jacques Franeau (Centre de la Faculte Polytechnique de Mons, Belg.). J. Phys. (Paris), 25: 356-8(Mar. 1964). (In French)

The absorption and backscattering of electrons by H_2O and D_2O were observed; no notable differences between were detected. Apparently the only notable isotopic effects in electron interactions with matter are those due to differences of molar volume. Therefore, empirical relations involving a dependence of backscattering or attenuation on the mass number of the scatter or absorber are not justified. Electron absorption can be used for isotopic analysis of specimens of known chemical composition. The backscattering of electrons by hydrogen and deuterium were also observed to be equal under the same conditions. (D.C.W.)

32774 TIME AND ENERGY ASPECTS IN NUCLEAR REACTIONS. R. van Dantzig (Instituut voor Kernfysisch Onderzoek, Amsterdam). Ned. Tijdschr. Natuurk., 30: 51-71(Feb. 1964). (In Dutch)

Time and energy concepts in nuclear reactions of the type A(a,b)B are discussed. A semi-classical representation of the reaction divides it into three stages as is illustrated in a time-energy diagram. Nuclear reactions are divided into two classes on the basis of their delay time, direct interactions and compound nuclear formation. The interference and distinction of these two are discussed. A simplified graphic representation is given. The physical background of experiments in this short time period are illustrated in a simple qualitative form. (J.S.R.)

32775 SOME RECENT RESEARCH WITH THE LIVERPOOL TANDEM VAN DE GRAAFF. L. L. Green (Univ. of Liverpool). Nucl. Instr. Methods, 28: 17-32(June 1964).

The elastic scattering of deuterons on ^{52}Cr and protons on ^{53}Cr was analyzed by the optical model, the parameters of which were used in DWBA calculations of the observed angular distributions for the ^{52}Cr(d,p)^{53}Cr reaction. Proton inelastic scattering by nuclei in the $f_{7/2}$ shell (^{50}Cr, ^{52}Cr, and ^{48}Ti) was also investigated. Level energies were obtained from spectra, and decay modes and branching ratios were determined from proton-gamma coincidences. Spins and parities were established by triple gamma correlation measurements. (D.C.W.)

32776 RECENT EXPERIMENTS AND RESEARCH PROGRAM IN LOW ENERGY NUCLEAR PHYSICS AT STRASBOURG AND SACLAY. A. Gallmann (Universite, Strasbourg). Nucl. Instr. Methods, 28: 33-43(June 1964).

The partial widths of electromagnetic transitions in ^{16}O were investigated by absolute measurement and by branching ratio measurement, and half lives in the nsec region were measured for energy levels of various nuclei by delayed coincidence methods. A direction-polarization angular correlation experiment on the 350-kev gamma rays emitted in the alpha decay of AcC(^{211}Bi → ^{207}Ti) confirmed the assignment $d_{\frac{5}{2}} \rightarrow S_{\frac{1}{2}}$. Coulomb excitation, reactions of light nuclei and Li ions, the reaction ^{27}Al(d,α)^{25}Mg, reduced widths of ^{10}B levels, ^{16}O and ^{18}O transitions, and positron activities of ^{14}O, ^{18}Ne, ^{26}Si, and ^{30}S were also studied. (D.C.W.)

32777 NUCLEAR STRUCTURE STUDIES WITH HIGH ENERGY HEAVY IONS. D. A. Bromley (Yale Univ., New Haven). Nucl. Instr. Methods, 28: 160-79(June 1964).

The advantages of heavy-ion beams for observations on nuclear structure are demonstrated by a brief review of some studies of ion inelastic scattering, transfer reactions, dissociation, and multiple Coulomb excitation. (D.C.W.)

32778 DOPPLER SHIFT AND COULOMB EXCITATION MEASUREMENTS OF E2 LIFETIMES IN LIGHT NUCLEI. H. E. Gove (Univ. of Rochester, N. Y.). Nucl. Instr. Methods, 28: 180-91(June 1964).

Recent measurements at Chalk River of E2 transition probabilities in light nuclei are discussed. The techniques employed were that of Doppler shift attenuation and Coulomb

excitation. The precision with which nuclear lifetimes can be measured using the Doppler shift method is illustrated, and a compilation of E2 transition probabilities for nuclei between A = 7 and A = 33 is presented. (auth)

32779 ELECTROMAGNETIC CROSS SECTIONS FOR ELECTRON AND NUCLEAR RESEARCH. H. W. Koch (National Bureau of Standards, Washington, D. C.). Nucl. Instr. Methods, 28: 199-204(June 1964).

Some analyses of the cross sections for electron pair production in the field of an electron and of a bare nucleus are briefly reviewed, and the importance of accurate triplet and nuclear pair cross section predictions is illustrated by results of analyses of the total cross sections of Si for x rays. (D.C.W.)

32780 NEUTRON AND PHOTON REACTION STUDIES USING LOW ENERGY ELECTRON LINEAR ACCELERATORS. F. W. K. Firk (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 28: 205-19(June 1964).

The use of electron linear accelerators in the determination of neutron resonance parameters (E_n< 100 kev) and in the measurement of energy spectra of photoparticles (E_γ < 50 Mev) is reviewed. The results of high-resolution (γ,n) and (γ,p) experiments emphasize the nuclear spectroscopy aspect of photoreactions in light nuclei. 103 references. (auth)

32781 ELASTIC AND INELASTIC ELECTRON SCATTERING. W. C. Barber (Stanford Univ., Calif.). Nucl. Instr. Methods, 28: 220-6(June 1964).

Some electron scattering (40 to 80 Mev) experiments on the electric and magnetic structure of nuclei are summarized. Experimental results are compared with theoretical predictions. (D.C.W.)

32782 SHELL MODEL CALCULATIONS ON ENERGY LEVELS IN $2s_{\frac{1}{2}}$ $1d_{\frac{5}{2}}$ SHELL. [PART] I. P. W. M. Glaudemans, G. Wiechers, and P. J. Brussaard (Rijksuniversiteit, Utrecht). Nucl. Phys., 56: 529-47(Aug. 1964).

The shell model is used to investigate quantitatively the nuclei in the range ^{29}Si-^{40}Ca. An inert ^{28}Si core is assumed with a two-particle interaction of the outer nucleons in the $2s_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$ shells. Mixing of all possible configurations in these shells is taken into account. The interaction matrix elements are reduced to linear expressions in 17 parameters (i.e. 15 two-particle interactions and 2 binding energies to the core). The methods, which were used, are discussed. The results give the energies, spins and configurations of about 400 nuclear levels, the values of the 17 parameters and the spectroscopic factors for stripping reactions. (auth)

32783 SHELL MODEL CALCULATIONS ON ENERGY LEVELS IN THE $2s_{\frac{1}{2}}$ $1d_{\frac{5}{2}}$ SHELL. [PART] II. P. W. M. Glaudemans, G. Wiechers, and P. J. Brussaard (Rijksuniversiteit, Utrecht). Nucl. Phys., 56: 548-68(Aug. 1964).

Shell model calculations on nuclei in the region 28 < A ≦ 40 are performed with the assumption of an inert ^{28}Si core. The numerical results are presented. The values of the two-particle interactions in the $2s_{\frac{1}{2}}$ $1d_{\frac{5}{2}}$ shell and the binding energies to the ^{28}Si core of $2s_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$ particles are derived from experimental level energies. The calculated energies, spins, and configurations of about 400 levels are listed. With the nuclear wave functions obtained, the spectroscopic factors for stripping reactions are calculated and, where possible, compared with the experimental data. (auth)

32784 CROSS SECTIONS FOR THE REACTIONS ^{39}K(n,p)^{39}A AND ^{39}K(n,α)^{36}Cl. R. Bass, U. Fanger, and Fatma M. Saleh (Johann Wolfgang Goethe Universitat, Frankfurt am Main). Nucl. Phys., 56: 569-76(Aug. 1964).

Absolute cross sections were measured for the nuclear reactions ^{39}K(n,p)^{39}Ar and ^{39}K(n,α)^{36}Cl in individual channels, leading to the ground and first three excited states of ^{39}Ar and to the ground and first-excited state of ^{36}Cl, over the neutron energy range from 4 to 8 Mev. In addition, total cross sections for fast neutron induced reactions of ^{39}K leading to either proton σ_p or α-particle emission σ_α were measured at neutron energies of 4 to 8 and 13.7 Mev. The experimental method consisted of bombarding a KI(Tl) scintillation crystal with monoenergetic fast neutrons and detecting the various charged reaction products either by simple scintillation pulse-height analysis, with or without pulse shape discrimination, or by (p,γ) and (α,γ) coincidence techniques. The results are discussed qualitatively in terms of a compound nucleus reaction mechanism and, pending a more detailed theoretical analysis, tentative spin assignments of $\frac{3}{2}$ to the first-excited state, and $\frac{5}{2}$ or $\frac{7}{2}$ to the third-excited state of ^{39}Ar are made. (auth)

32785 CONCERNING THE T = 1, J = 1$^-$ STATES IN O^{16}. Joerg Eichler (California Inst. of Tech., Pasadena). Nucl. Phys., 56: 577-92(Aug. 1964).

The particle-hole excitations with T = 1, J = 1$^-$ in ^{16}O are studied for finite shell-model potentials which permit the excited particle to escape into the continuum. Besides the energies of the excited states and their dipole widths, one can also calculate particle widths, differential and total cross sections for photodisintegration and furthermore investigate the influence of direct transitions on angular distributions and the shape of the resonances. The results are discussed and compared with experiment. (auth)

32786 PERIPHERAL REACTIONS IN COPPER INDUCED BY 19 Gev PROTONS. G. Rudstam (CERN, Geneva). Nucl. Phys., 56: 593-603(Aug. 1964).

The reactions ^{65}Cu(p,pπ^-)^{65}Zn and ^{65}Cu(p,pπ^+)^{65}Ni were studied at 19 Bev. The ratio between the cross sections is in agreement with the theory developed by Ericson, Selleri, and Van de Walle. The experiment thus supports the application of the peripheral interaction model to this kind of nuclear reaction. (auth)

32787 PHOTODISINTEGRATION OF Mg^{24}. B. Forkman and W. Stiefler (Univ. of Lund, Sweden). Nucl. Phys., 56: 604-14(Aug. 1964).

The energy spectra and the angular distributions of the photoprotons produced by the bremsstrahlung irradiation of magnesium were measured at maximum exposure energies of 20.5, 23, 26.5 and 40 Mev. The difference spectra were analysed to obtain information about the decay mode of the magnesium nucleus. The branching ratios to the hole states in sodium were calculated assuming a single-particle excitation model. (auth)

32788 NUCLEON DECAY FROM THE GIANT E1 STATES IN Mg^{24}. B. Diehl, B. Forkman, and W. Stiefler (Univ. of Lund, Sweden). Nucl. Phys., 56: 615-24(Aug. 1964).

A comparison between theoretical predictions and experimental results is performed for the proton decay from the giant dipole states in ^{24}Mg. A satisfactory agreement is obtained at K = 0 excitation energies concerning both the proton energy spectrum and the angular distributions. At K = 1 excitation energies the pure particle-hole excitation model must be modified in order to obtain agreement with experiment. One type of such a modification is qualitatively discussed. (auth)

32789 THE 0^+ EXCITED STATE OF Ce^{140} STUDIED BY THE DECAY OF Pr^{140}. Kazuo Hisatake (Tokyo Inst. of Tech.), Yoshiteru Yoshida, Kiichi Etoh, and Tōru Murata. Nucl. Phys., 56: 625-35(Aug. 1964).

The 1.902-Mev 0^+ state in ^{140}Ce was studied by the decay of ^{140}Pr. First, the 0.306-Mev gamma ray, which was assigned to be the transition from the 1.902-Mev 0^+ (denoted by $0^{+\prime}$) to the 1.596-Mev 2^+ states, was found in the coincidence spectrum gated by the 1.596-Mev gamma ray. The gamma-gamma angular correlation for the 0.306-1.596 Mev cascade was found to be consistent with the (0-2-0) spin sequence. The 0.306, 1.596, and 1.902-Mev internal conversion electrons were observed using a sector-type double focusing spectrometer. The branching ratio of the $(0^{+\prime} \rightarrow 0^+)$ to the $(0^{+\prime} \rightarrow 2^+)$ transition was obtained to be 1.13 ± 0.12. The strength parameter ρ is discussed assuming the partial life of the $(0^{+\prime} \rightarrow 2^+)$ transition. The log ft values from ^{140}Pr to the ground, the first 2^+ and the second 0^+ excited states of ^{140}Ce were determined to be 4.4, 6.0 and 5.9, respectively. From the log ft values the spin and parity of the ground state of ^{140}Pr is assigned to be 1^+. (auth)

32790 ANTISYMMETRIZATION OF A UNIFIED NUCLEAR REACTION THEORY. W. M. MacDonald (Faculte des Sciences, Orsay, France). Nucl. Phys., 56: 636-46 (Aug. 1964).

A completely antisymmetrized version of the unified nuclear reaction theory given earlier is developed by using a theorem due to Brenig. The theory leads naturally to a shell-model description of the compound nuclear states. (auth)

32791 A SELF-CONSISTENT TWO-BODY METHOD FOR THREE-BODY SYSTEMS AND THE HYPERNUCLEUS $_{\Lambda}Be^9$. A. R. Bodmer and Shamsher Ali (Univ. of Manchester, Eng.). Nucl. Phys., 56: 657-82(Aug. 1964).

The variational principle is applied to a bound s state of three particles to obtain coupled, effective two-body Schrödinger equations appropriate to the best wave function of the product form $g_1(r_1)g_2(r_2)g_3(r_3)$, where r_1, r_2, and r_3 are the interparticle distances. For any pair of particles one then has an eigenvalue problem for which the effect of the third particle can be represented simply by an additional potential which depends on the g_i pertaining to the other two pairs. If these g_i are sums of exponentials and the corresponding interactions are also sums of exponential or Yukawa potentials, the additional potential is an algebraic expression. The method was used in a detailed study of the hypernucleus $_{\Lambda}Be^9$ treating this as a three-body system consisting of two α-particles and the Λ hyperon. A variety of α-α potentials were considered whose s wave phase shifts were calculated. The spin-averaged volume integral of the Λ-N interaction is found to be in good agreement with the values obtained from $_{\Lambda}He^5$ and $_{\Lambda}C^{13}$ for α-α potentials which give phase shifts consistent with the experimental ones. The re-arrangement energy of the ^8Be core due to distortion by the Λ is found to be about one Mev. Assuming that the α-Λ interaction in $_{\Lambda}Be^9$ is known from $_{\Lambda}He^5$ it is also shown that the Λ is a quite sensitive probe into the α-α interaction. With hard core α-α potentials, which we have rather systematically investigated, one finds that a potential is selected which gives a very good fit to the experimental phase shifts, thus strongly supporting the assumed description of $_{\Lambda}Be^9$ and in particular the α-particle model of ^8Be. (auth)

32792 THE VALIDITY OF THE DOPPLER APPROXIMATION IN NUCLEAR ELASTIC SCATTERING OF CAPTURE GAMMA RAYS. B. Arad (Huebschmann), G. Ben-David (Davis), and Y. Schlesinger (Soreq Research Establishment, Nahal Soreq, Israel). Nucl. Phys., 56: 683-8(Aug. 1964).

Evaluation of resonant scattering of gamma rays from nuclear levels requires the integration of the product of the source line and resonance level curves. This integral was evaluated for the general case of two Doppler broadened curves, with arbitrary temperatures for source and scatterer nuclei, different natural line widths, and a separation δ ev between the two maxima. It is shown that the shape of a thermal neutron capture gamma ray line can be accurately represented by the pure Doppler shape. Only in special cases, however, can the nuclear level be approximated by the pure Doppler form. (auth)

32793 DETERMINATION OF CONVERSION COEFFICIENTS FROM THE DECAY OF Pb^{202m} BY MEANS OF A SEMICONDUCTOR DETECTOR. H. E. Bosch (Instituto de Investigacion Aeronautica y Espacial, DINFIA, Buenos Aires), F. Krmpotic, and A. Plastino. Nucl. Phys., 56: 689-94(Aug. 1964).

New attempts to determine conversion coefficients using semiconductor detectors were made. In this case the 0.422 and 0.787-Mev transitions from the decay of ^{202m}Pb were studied. Conversion coefficients were determined by means of the electron-gamma coincidence method, replacing the conventional magnetic spectrometer by a semiconductor counter. The value of the K conversion coefficient corresponding to the E2 0.422-Mev transition is $\alpha_K(0.422) = 0.032 \pm 0.002$. That corresponding to the 0.787-Mev E5 transition is $\alpha_K(0.787) = 0.008 \pm 0.004$. (auth)

32794 THEORY OF NUCLEAR REACTIONS. V. PENETRATION FACTORS FOR CHARGED PARTICLES IN LOW ENERGY NUCLEAR REACTIONS. J. P. Jeukenne (Univ. of Liège). Nucl. Phys., 58: 1-8(Sept. 1964).

The choice of a definition for a penetration factor is discussed, with emphasis on the condition of channel radius independence. As illustrative examples, the experimental data for the reactions $^3He(d,p)$ and $^3H(d,n)$ are analyzed, and it is shown that the best fit is most readily obtained for the penetration factors independent of the channel radii. (auth)

32795 EMISSION OF ^8Li FRAGMENTS FROM INTERACTIONS OF 9 AND 24 Gev PROTONS WITH HEAVY EMULSION NUCLEI. W. Gajewski, J. Pniewski, J. Siemińska, J. Suchorzewska, and P. Zieliński (Univ. of Warsaw and Inst. of Nuclear Research, Warsaw). Nucl. Phys., 58: 17-31(Sept. 1964).

A full account of the work concerning 445 hammer tracks collected from 9 and 24 Bev proton interactions with heavy emulsion nuclei is presented. The conditions of the routine work on hammer tracks are established. The frequency of emission of ^8Li fragments for different N_h intervals was estimated. Taking into account the effect of the motion of the nucleus the velocity fluctuations and nuclear recoil resulting from the fragment emission, the angular distribution and the energy spectrum were compared with the results of evaporation theory. The values of the parameters T, V, and β, representing the temperature, Coulomb barrier, and average velocity of the emitting nucleus, were estimated on different assumptions. A high value of T and a low value of V were obtained. (auth)

32796 ELASTIC SCATTERING OF 31 Mev PROTONS FROM H^2, He^3, N^{14}, AND O^{16}. C. C. Kim, S. M. Bunch, D. W. Devins, and H. H. Forster (Univ. of Southern California, Los Angeles). Nucl. Phys., 58: 32-48(Sept. 1964).

The differential elastic scattering cross sections for

31.0-Mev protons were determined for gaseous, isotopic targets of ^{2}H, ^{3}He, ^{14}N and ^{16}O at c.m. angles ranging from ≈6 to ≈160°. An optical model analysis of the experimental data was performed on ^{3}He, ^{14}N and ^{16}O using a model which included both volume and surface absorption. Good fits were obtained over most of the experimental range. Optical model parameters corresponding to best fits are presented and compared with those obtained in this energy range for other light nuclei. (auth)

32797 HALF-LIFE MEASUREMENTS IN ^{90}Zr, ^{92}Mo, AND ^{85}Rb. K. E. G. Loebner (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys., 58: 49-55(Sept. 1964).

The half life of the 8^{+} level in ^{90}Zr at 3.595 Mev and that of the 8^{+} level in ^{92}Mo at 2.795 Mev were measured to be 125 ± 6 and 192 ± 7 nsec, respectively. These half lives correspond to enhancement factors of only 2.4 ± 0.1 and 1.8 ± 0.7, respectively, compared to the single-particle Weisskopf estimate for the E2 gamma transitions in ^{90}Zr and ^{92}Mo from the 8^{+} to the 6^{+} level. The half-life measurement of the 513-kev level of ^{85}Rb yielded a value 980 ± 20 nsec. (auth)

32798 THE DECAY OF Br^{82}. T. J. Kennett, I. B. Webster, and W. V. Prestwich (McMaster Univ., Hamilton, Ont.). Nucl. Phys., 58: 56-64(Sept. 1964).

A re-examination of the decay of ^{82}Br has revealed the presence of two new transitions at 220 ± 10 and 1648 ± 10 kev. The intensity of these gamma rays is 0.8% and together with a 777-kev transition they form a triple cascade. This branch leads to a level at 2426 ± 15 kev. Transitions at 250, 350, 1800, and 2000 kev previously reported were not found and appear to be attributable to summing and scattering effects. (auth)

32799 DISTORTED-WAVE THEORY OF DEUTERON STRIPPING REACTIONS. Makoto Tanifuji (Hosei Univ., Tokyo). Nucl. Phys., 58: 81-107(Sept. 1964).

A theory of deuteron stripping reactions without zero-range assumption is developed from the viewpoint that the waves of the nucleons of the incident deuteron are distorted by their respective potentials. Formulas for the transition amplitude are given for the cases of normal stripping reactions, anomalous stripping reactions including collective excitations, and exchange stripping reactions. Wilkinson's conclusion on stripping reactions with low Q values and low incident energies is qualitatively examined. (auth)

32800 EVAPORATION SPECTRA OF NEUTRONS FROM $Mn^{55}(\alpha,n)Co^{58}$ AND $Fe^{56}(\alpha,n)Ni^{59}$ REACTIONS AT E_α = 14, 17 AND 20 Mev. A. Alevra, R. Dumitrescu, I. Lukas, M. T. Magda, N. Martalogu, D. Plostinaru, D. Poenaru, E. Trutia, I. Vilcov, and N. Vilcov (Inst. for Atomic Physics, Bucharest). Nucl. Phys., 58: 108-12(Sept. 1964).

The variation of the nuclear temperature with the bombarding energy was studied in (α,n) reactions on ^{55}Mn and ^{56}Fe, at E_α = 14, 17, and 20 Mev. An increase of the nuclear temperature with the bombarding energy was observed. Their variation was related to noncompound processes appearing in (α,n) reactions. (auth)

32801 RADIATIVE CAPTURE OF PROTONS BY B^{11} AND THE GIANT DIPOLE RESONANCE IN C^{12}. R. G. Allas, S. S. Hanna, Luise Meyer-Schuetzmeister, and R. E. Segel (Argonne National Lab., Ill.). Nucl. Phys., 58: 122-44(Sept. 1964).

The radiative capture of protons by ^{11}B was studied in the energy range 4 Mev ≦ E_p ≦ 14 Mev. The ground-state gamma-ray yield follows the giant resonance observed in photonuclear studies with some structure apparent. The gamma ray to the first excited state also shows a giant resonance whose center is displaced upward by about 4 Mev from the ground-state giant resonance. Considerable structure is present in the giant resonance built upon the first excited state. For both gamma rays, the angular distributions vary but little with energy – they are peaked at 90° for the ground-state transition and nearly isotropic for the excited-state transition. For both gamma rays, the distributions exhibit a positive $\cos\theta$ term which increases with increasing energy. The angular distribution data, analyzed in terms of Legendre polynomials, are compared with theoretical predictions and shown to be in agreement with the results of particle-hole configuration calculations. (auth)

32802 THEORY OF COULOMB EXCITATION IN THE COLLISION OF IDENTICAL NUCLEI. F. I. Dalidchik and Yu. S. Sayasov (Inst. for Chemical Physics, Moscow). Nucl. Phys., 58: 145-57(Sept. 1964).

A theory of Coulomb excitation in collisions of identical nuclei is developed. It is shown that under the usual quasi-classical conditions the differential cross sections for Coulomb excitation of nuclei (just as the Mott cross section for elastic Coulomb scattering of identical particles) display considerable oscillations with respect to the scattering angle. If the level excitation energy is sufficiently small as compared with the energy of colliding particles these oscillations are described by a simple modification of the exchange term in the Mott formula for elastic scattering. The character of oscillations in the neighborhood of 90° (c.m.s.) proves essentially dependent on the multiple moment of the transition which points to a possible use of this relation for the unambiguous determination of multipole moments of the transitions. (auth)

32803 DIAGONAL APPROACH TO A QUADRATIC FORM OF BOSONS AND EXCITED STATES OF SPHERICAL NUCLEI. J. Touchard (Faculte des Sciences, Orsay, France). Nucl. Phys., 58: 158-70(Sept. 1964). (In French)

Using a conventional mixture of pairing and quadrupole forces and the model hamiltonian which leads to linearized equations of motion for excited states of spherical even nuclei, a comparison is made between the exact solution and the approximate solution with an uncorrelated ground state. It is shown that an appreciable difference for the wave function of the collective state may appear and that a first-order perturbation correction reduces suitably the difference. (auth)

32804 BACKSCATTERING OF POSITONS. A. Bisi and L. Braicovich (Politecnico, Milan). Nucl. Phys., 58: 171-6(Sept. 1964).

A new method for measurement of the backscattering coefficient of positrons is proposed, based on the behavior of positrons annihilating in solids. The backscattering coefficient of positrons is measured for several materials; the relation between the backscattering coefficient and the square root of the atomic number is found to be linear. The results are compared with the results of previous measurements regarding positrons and electrons. (auth)

32805 THE EXCITATION CROSS SECTION OF THE Na^{23} NUCLEUS UP TO 4 Mev BY THE HAUSER-FESHBACH THEORY. W. Gloeckle and D. Emendoerfer (Technische Hochschule, Stuttgart). Nukleonik, 6: 153-7(May 1964). (In German)

A study was made to transfer a mean pattern of the experimental excitation cross section of the ^{23}Na nucleus into

the resonance range. It succeeds satisfactorily through the assumption of an intermediate nucleus process in the form of the Hauser-Feshbach theory. The transmission coefficients were obtained with the help of the optical model from the integrated total and the integrated nonelastic cross sections. The "compound elastic" cross section was determined iteratively from the required equality of values assumed and calculated by the Hauser-Feshbach theory. By a superposition of four rotation bands, the experimental term diagram of ^{23}Na was represented clearly up to 3.5 Mev, and the experimentally incomplete spin distribution of the residual nuclear state required for carrying out the Hauser-Feshbach calculation was completed from the theory. (tr-auth)

32806 COHERENT PRODUCTION OF PIONS BY HIGH-ENERGY PIONS ON COMPLEX NUCLEI. A. Caforio (Università, Bari, Italy), D. Ferraro, S. Semeraro, et al. Nuovo Cimento (10), 32: 1471-96(June 16, 1964).

Limits to the mean-free-path in nuclear emulsion for coherent multiple production of pions by diffraction and Coulomb dissociation were established by measurements of angles only. By a more detailed analysis considering momentum determinations, the mean-free path for the coherent reaction $\pi^- -$nucleus $\rightarrow 2\pi^- - \pi^+ -$nucleus was estimated to be 51 m. An analysis of the momentum transfer distributions, together with bubble-chamber data, indicates that all the complex nuclei in the emulsion act as targets for the reaction. (D.C.W.)

32807 ON THE ANALYSIS OF MESONIC HYPER-FRAGMENTS PRODUCED BY 1.5 Gev/c K^- INTERACTIONS. A. W. Key, S. Lokanathan, and Y. Prakash (Oxford Univ.). Nuovo Cimento (10), 32: 1541-7(June 16, 1964).

The results of an analysis of the mesonic decays of 61 hyperfragments with ranges >10 μ are presented. The hyperfragments were produced by interactions of 1.5-Bev/c mesons (K^-) in K5 emulsion. (D.C.W.)

32808 THERMODYNAMICAL APPROACH TO THE NUCLEAR DYNAMIC POLARIZATION. V. Montelatici (CNEN, Frascati, Italy). Nuovo Cimento (10), 32: 1613-21(June 16, 1964).

If a system of particles with spin is divided into groups according to spin state, a chemical potential can be assigned to each group. The entropy production rate is written as function of chemical potentials and transition probabilities. At thermodynamic equilibrium the entropy production must be zero, and the nuclear dynamic polarization is derived for a system of electron and nuclear magnetic moments with spin $\frac{1}{2}$. The results are consistent in first-order approximation with those obtained by solving the rate equations. (auth)

32809 TIME-REVERSAL INVARIANCE IN STRONG INTERACTIONS. I. β-γ_1-γ_2 ANGULAR CORRELATION IN ^{47}Ca. E. Fuschini, V. Gadjokov, C. Maroni, and P. Veronesi (Università, Bologna). Nuovo Cimento (10), 33: 709-21 (Aug. 1, 1964).

In a β-γ_1 (mixed)-γ_2 (pure) angular correlation, a term odd under gamma interchanging must be present if time-reversal invariance does not hold in nuclear γ transitions. The asymmetry was sought in a β-γ_1-γ_2 cascade of ^{47}Ca and was found to be zero within one standard deviation of about 0.6%. The bearing of this result on an upper limit for F is discussed (F is the relative amplitude of the irregular part of the hamiltonian with respect to the regular one). (auth)

32810 NUCLEAR MAGNETIC RESONANCE LINE SHIFT IN CADMIUM. E. F. W. Seymour and G. A. Styles (Univ. of Leeds, Eng.). Phys. Letters, 10: 269-70(June 15, 1964).

Measurements of the shift of the nuclear magnetic resonance of ^{113}Cd in metallic cadmium were made over the temperature range 77 to 615°K. A plot of the shift, measured at 6300 gauss, versus absolute temperature is shown. Explanation is given of the large change of shift with temperature and the further substantial change on melting. (L.B.S.)

32811 EXACT NUMERICAL SOLUTION FOR ASYMMETRIC CHARGE TRANSFER. R. A. Willet and S. G. Elkomoss (Douglas Missile and Space Systems Division, Santa Monica, Calif.). Phys. Letters, 10: 284-5(June 15, 1964).

The basic equations governing non-resonant reactions are reduced essentially to a Riccati equation with real variable coefficients, for which accurate numerical integration is possible. (L.B.S.)

32812 ISOMERISM IN Po^{211} AND Po^{212}. N. Auerbach and I. Talmi (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 10: 297-9(June 15, 1964).

A shell model calculation of the ^{211}Po and ^{212}Po energy levels is described. It is found that the same interaction between an $h_{9/2}$ proton and a $g_{9/2}$ neutron gives rise to the observed isomeric states in both nuclei. (L.B.S.)

32813 DECAY PROPERTIES OF THE DELAYED PROTON EMITTER Ne^{17}. J. M. D'Auria and I. L. Preiss (Yale Univ., New Haven). Phys. Letters, 10: 300-3(June 15, 1964). (NYO-1957-38)

An experiment, using ^{9}Be and ^{12}C targets irradiated with 120-Mev ^{12}C beams, to determine the half life of ^{17}Ne and to obtain information of its decay modes and associated proton spectrum is described. Diagrams of target geometry and electronic equipment used in proton spectrum and half life analyses, typical half life curves, and the suggested decay scheme are given. Analysis of decay beta indicates that the positron decay of ^{17}Ne populates the unstable levels of ^{17}F and exhibits a half life of 690 ± 30 msec. The proposed decay scheme indicates a ground state spin of $(\frac{1}{2}^-)$ for ^{17}Ne, which is consistent with both the shell model predictions and the results on the mirror nucleus ^{17}N. (L.B.S.)

32814 TIME DEPENDENCE OF THE 133 kev–482 kev $\gamma\gamma$-ANGULAR CORRELATION IN THE DECAY OF Hf^{181} FOR DIFFERENT LIQUID SOURCES. C. Guenther, W. Engels, U. Wehmann, and E. Bodenstedt (Universität, Bonn). Phys. Letters, 10: 303-5(June 15, 1964).

The time dependence of the angular correlation of the 133-kev–482-kev $\gamma\gamma$-cascade was measured by means of a fast time-to-pulse height converter in connection with a multichannel analyzer for the following sources: HfF_4 solved in concentrated Hf (38–40%), $HfOCl_2$ solved in dilute HCl, $Hf(SO_4)_2$ solved in concentrated H_2SO_4 (95–97%), and $HfO(CH_3COO)_2$ solved in CH_3COOH (100%). It is concluded that the Dillenburg-Maris effect is not responsible for the observed time dependence of $A_k(t)$. The results were in good agreement with the theory of Abragam and Pound. (L.B.S.)

32815 COULOMB EXCITATION OF THE 14.4 kev STATE IN Fe^{57}. M. F. Thomas and M. A. Grace (Oxford Univ.). Phys. Letters, 10: 306-8(June 15, 1964).

Thick targets on copper backings of ^{57}Fe bombarded with He^+ beams between 0.5 and 1.1 Mev were used in an experiment to measure the E2 constituent in the 14.4-kev transition. The quadrupole admixture was detected directly using the Coulomb excitation technique which preferentially

excites through the electric multipole matrix elements. Good agreement, which confirms the Coulomb excitation mechanism, was obtained between experimental points and the theoretical electric quadrupole excitation function fitted with the value for B(E2) of 9.7×10^{-52} e^2cm^4. (L.B.S.)

32816 ELECTRON SCATTERING FORM FACTORS IN C^{12}. G. R. Bishop and A. Bottino (Ecole Normale Supérieure, Orsay, France). Phys. Letters, 10: 308-10 (June 15, 1964).

Theoretical values of the inelastic form factors for the even parity levels, 15.1-Mev, $J^P = 1^+$, T = 1 and 16.1-Mev, $J^P = 2^+$, T = 1, in ^{12}C were calculated for comparison with measurements made at Orsay. The single particle operators were used to calculate matrix elements, with modifications for the use of particle-hole wave functions. Calculations were limited to the $1^{-1}_{p\frac{3}{2}}$ $1_{p\frac{1}{2}}$ state. Theoretical calculations led to an overestimate of the form factor by a factor of approximately five for the 15.1-Mev level and approximately four for the longitudinal part for the 16.1-Mev level. It is concluded that the description of the ground state of ^{12}C as a closed $p^3/_2$ subshell needs modification. (L.B.S.)

32817 PHOTOPROTONS FROM Zr. I. I. Dushkov (Moscow State Univ.), B. S. Ishkhanov, I. M. Kapitonov, B. A. Yur'ev, and V. G. Shevchenko. Phys. Letters, 10: 310-12(June 15, 1964).

Results of measurements of the (γ,n) cross section and of angular distributions of photoprotons produced by bremsstrahlung at $E_{\gamma\,max}$ = 22, 25, and 34 Mev and comparisons with shell-model calculations of the γ-absorption cross section in ^{90}Zr are reported. (L.B.S.)

32818 EXCITATION OF THE 15.11 Mev-LEVEL IN C^{12} BY INELASTIC SCATTERING OF ELECTRONS. F. Gudden (Technische Hochschule, Darmstadt, Ger.). Phys. Letters, 10: 313(June 15, 1964).

Results of calculations of the reduced transition probability for M1 transitions are reported and are shown as functions of inelastic momentum transfer squared. (L.B.S.)

32819 A MODEL OF CHARGE SYMMETRICAL PAIRING CORRELATIONS IN LIGHT NUCLEI. P. Vogel (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 10: 314-15(June 15, 1964).

It is shown that the introduction of correlated quadrupoles with their free parameters into the trial functions of the variational problem is equivalent to a nonlinear transformation of the Fermi operators. A more general linear transformation is also suggested. (L.B.S.)

32820 THE INTERACTION OF 350 kev POLARIZED NEUTRONS WITH ORIENTED Ho^{165} NUCLEI. R. Wagner (Oak Ridge National Lab., Tenn.), P. D. Miller, T. Tamura, and H. Marshak. Phys. Letters, 10: 316-18(June 15, 1964).

The interaction of polarized and unpolarized 350-kev neutrons with orientated and unorientated ^{165}Ho was investigated using a 3-Mv Van de Graaff in conjunction with a time-of-flight spectrometer. A deformation effect in the total cross section of the orientated target was found to be in quantitative agreement with a coupled channel calculation. The spin-spin interaction was found to be nearly two orders of magnitude smaller than the spin-orbit interaction for this nucleus. (L.B.S.)

32821 HYPERFINE SPLITTING AND g-FACTOR OF THE 80.6 kev STATE OF Er^{166}. H. Dobler, G. Petrich, S. Huefner, P. Kienle, W. Wiedemann, and H. Eicher (Technische Hochschule, Munich). Phys. Letters, 10: 319-20(June 15, 1964).

The hyperfine splitting of the 80.6-kev $(2^+)-(0^+)-\gamma$-transition in ^{166}Er was investigated by the Mössbauer method, with $ErCl_3 \cdot H_2O$ used as the resonance absorber in a standard transmission measurement, and with a ^{166}Ho gamma source. A single magnetic coupling constant was used to fit the absorption spectrum. The g-factor was found to be 0.312 ± 0.10, which is in close agreement with the result of the angular correlation experiment. (L.B.S.)

32822 MASS DISTRIBUTION IN FISSION AND THE THEORY OF RANDOM FLIGHTS. R. Ramanna (Atomic Energy Establishment, Trombay, India). Phys. Letters, 10: 321-3(June 15, 1964).

It is shown, without reference to deformation parameters and excitation energies, that the distribution of mass in nuclear fission is a result of nucleonic Brownian motion and the effect of the shells, and can be obtained by the application of the theory of random flights. (L.B.S.)

32823 INELASTIC SCATTERING OF PROTONS BY Cd^{114} AND POSSIBLE QUADRUPOLE-OCTUPOLE TWO-PHONON STATES. M. Sakai (Tokyo Univ.) and T. Tamura. Phys. Letters, 10: 323-5(June 15, 1964).

A coupled channel calculation is used to analyze experimentally obtained cross sections for the inelastic scattering of 12.16-Mev protons by ^{114}Cd, along with previously reported data. Comparison with theoretical differential cross sections shows good agreement. The possibility that the last five observed states, for which no cross sections have been determined, could be members of the five quadrupole-octupole two phonon 1^-, 2^-, 3^-, 4^-, and 5^- states is considered. (L.B.S.)

32824 STUDY OF THE REACTIONS (p,2p) AT 150 Mev ON Ca^{40}, Sc^{45}, Ti^{48}, AND V^{51}. C. Ruhla, M. Riou, R. A. Ricci, M. Arditi, H. Doubre, J. C. Jacmart, M. Liu, and L. Valentin (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Phys. Letters, 10: 326-30 (June 15, 1964). (In French)

Reactions (p,2p) on ^{40}Ca, ^{45}Sc, ^{48}Ti, and ^{51}V were studied at 150 Mev. Angular correlation distributions of the quasi-elastic scattered protons emitted in the same plain as the incident proton, with opposite angles and neighboring energies, were considered. Effective cross sections were compared with known cross sections of (p,p) scattering. Spectra were studied at 36, 40, 44, 48, and 52°; relative distributions of angular correlation were determined for each peak. Binding energies and f, d, s, or p assignments are given for the peaks. (M.J.T.)

32825 DIRECT DETERMINATIONS OF THE $Sm^{144}-Nd^{144}$ AND $Nd^{150}-Sm^{150}$ ENERGY DIFFERENCES. W. McLatchie, R. C. Barber, H. E. Duckworth, and P. Van Rookhuyzen (McMaster Univ., Hamilton, Ont.). Phys. Letters, 10: 330-1(June 15, 1964).

Mass differences of the isobaric pairs, $^{144}Sm-^{144}Nd$ and $^{150}Nd-^{150}Sm$, were determined directly using a high resolution mass spectrometer. The values obtained were 1.818 ± 0.003 Mev and 3.384 ± 0.004 Mev, respectively. The results indicate that ^{150}Nd is stable, and that the energy available for the unobserved $^{150}Pm-^{150}Nd$ decay is 76 ± 30 kev. (L.B.S.)

32826 ON NUCLEAR LEVEL DENSITIES. H. A. Weidenmueller (Universität, Heidelberg). Phys. Letters, 10: 331-3(June 15, 1964).

Qualitative arguments that the model on which the formula for the level density is based is incorrect are presented, and the assertion that the statistical theory

of nuclear reactions predicts an essentially exponential increase of the density ρ, of compound states with excitation energy E, is questioned. Possibilities of detecting experimentally deviations from the predicted dependence of ρ on E are also discussed. (L.B.S.)

32827 SECOND ORDER COULOMB EXCITATION VIA THE GIANT DIPOLE RESONANCE. N. MacDonald (Univ. of Glasgow). Phys. Letters, 10: 334-5(June 15, 1964).

It is shown by a model of a deformed nucleus in which $|2_1^+\rangle$ is a rotational state that the second order correction, suggested by Eichler, to the cross section for the first order excitation of the 2^+ state of even nuclei is proportional to a quantity, $\eta \ll 1$. (L.B.S.)

32828 REVERSE ROTATION OF GAMMA-RAY ANGULAR PATTERN WITH CHANGING ALPHA-SCATTERING ANGLE. D. R. Inglis (Argonne National Lab., Ill.). Phys. Letters, 10: 336-8(June 15, 1964).

A simple and directly perceptible explanation of the opposite rotation of the symmetry pattern of the gamma rays accompaning the rotation of alpha-scattering angle through the characteristic maxima and minima, observed in inelastic alpha scattering from a deformed nucleus, is presented. (L.B.S.)

32829 EFFECT OF 3-3 RESONANCE ON PHOTOPION PRODUCTION FROM CARBON NUCLEI. S. Kabe, K. Kato, T. Kifune, Y. Kimura, M. Kobayashi, K. Kondo, and T. Nishikawa (Tokyo Univ.). Phys. Letters, 10: 354-6 (June 15, 1964).

The effect of the 3-3 resonance on photopion production and how this effect changes its behavior due to nuclear many-body effects are examined. The differential cross sections for π^+ photoproduction from carbon by 305 and 400 Mev photons were found to be in good agreement with theoretical curves obtained by use of the nucleon momentum distribution of a Gaussian type and the optical model theory. The 3-3 resonance was found in the case of the bound nucleon, and no appreciable nuclear effect other than that due to the nucleon momentum distribut'on was observed. (L.B.S.)

32830 HARD-CORE Λ-Λ POTENTIAL. Y. C. Tang (Brookhaven National Lab., Upton, N. Y.), R. C. Herndon, E. W. Schmid. Phys. Letters, 10: 358-9(June 15, 1964). (BNL-8029)

Calculations for the binding energy of ΛΛ ^{10}Be and other ΛΛ-hypernuclei with a hard core potential are reported. The results are tabulated for various values of $V_{\Lambda\Lambda}$. (L.B.S.)

32831 NUCLEAR RESONANCE FLUORESCENCE IN Cu^{65}. G. B. Beard (Argonne National Lab., Ill. and Wayne State Univ., Detroit). Phys. Rev., 135: B577-80(Aug. 10, 1964).

The 1.114-Mev excited state of ^{65}Cu was investigated by means of nuclear resonant fluorescent scattering and self-absorption experiments. The level width was found to be $(1.51 \pm 0.38) \times 10^{-3}$ ev, corresponding to a mean life of $(4.4 \pm 1.1) \times 10^{-13}$ sec. Angular-distribution measurements of the resonantly scattered gamma rays gave $\delta = (E2/M1)^{1/2} = -0.52$. From these values, $B(E2)\downarrow = (0.023 \pm 0.007) \times 10^{-48}$ e^{2}cm^4 and $B(M1)\downarrow = (0.08 \pm 0.02)$ $(e\hbar/2Mc)^2$. The lifetime agrees with other recent measurements, but the value for δ disagrees with results from Coulomb-excitation experiments. (auth)

32832 PRECISE SHAPE MEASUREMENTS OF BETA SPECTRA OF Y^{90} AND Y^{91}. L. M. Langer, E. H. Spejewski, and D. E. Wortman (Indiana Univ., Bloomington). Phys. Rev., 135: B581-6(Aug. 10, 1964).

Precise measurements of the detailed shapes of the beta spectra of ^{91}Y and ^{90}Y were made in order to determine better to what extent the theory of beta decay in its present approximation is adequate to describe the distributions which are observed for these unique, $\Delta I = 2$, party changing transitions. The use of an integrally biased semiconductor as the detector in a high resolution magnetic spectrometer provided an extremely low background which facilitated the accurate determination of the end points with a minimum amount of extrapolation. A proper end-point determination is necessary for a meaningful shape-factor analysis. In both cases, it was found that the experimental shape factor shows a small but definite deviation from the theoretical expectation. For a theoretical shape factor, $L_0q^2 + 9L_1$, with L_0 and L_1 based on exact electron radial wave functions including the effects of a finite nuclear radius, the necessary correction can be supplied by an empirical factor of the form $1 + b/W$ with $0.3 \leq b \leq 0.4$. The end points of the ^{91}Y and ^{90}Y spectra were determined to be 1.545 ± 0.005 and 2.273 ± 0.005 Mev, respectively. (auth)

32833 RADIATIVE DECAY OF SOME LOW-LYING STATES OF Mg^{27}. J. A. Becker (Brookhaven National Lab., Upton, N. Y.), G. E. Mitchell, and P. F. Donovan. Phys. Rev., 135: B587-91(Aug. 10, 1964). (BNL-7743)

The gamma-ray de-excitation of several low-lying states of ^{27}Mg was observed by measuring proton-gamma-ray coincidences. The levels in ^{27}Mg were populated using the ^{26}Mg(d,p)^{27}Mg reaction. The results are as follows: the 0.984-Mev level decays to the ground state 100%; the 1.69-Mev level decays to the ground state 100% with no observed transition to the 0.984 state (limit < 1%); the 1.94-Mev level decays to the first excited state 70 ± 4% and to the ground state 30 ± 7% with no observed transition to the 1.69-Mev second excited state (limit < 1%); and the 3.11-Mev state was observed to decay to the 1.94-Mev level, however, there may be other branches. The 3.47- and 3.48-Mev doublet (unresolved) decays to the ground state 100%—limits on cascades through the 0.984- and 1.69-Mev states are < 6% and < 3%, respectively; the 3.56-Mev level decays primarily to the ground state ~100%—limits for cascades through the 0.984- and 1.69-Mev states are < 4% and < 5%, respectively; and the 3.76- and 3.78-Mev doublet (unresolved) decays to the 1.69-Mev level ~100%—limits for the ground-state transition and the cascade through the 0.984-Mev state are both < 4%. (auth)

32834 UNCOUPLED NUCLEAR MATTER APPROXIMATION. Kleber S. Masterson, Jr. (Univ. of California, San Diego, La. Jolla). Phys. Rev., 135: B595-600(Aug. 10, 1964).

A relatively simple nuclear matter approximation, based on a result derived by Masterson and Sawada, is evaluated. In this approximation free kinetic energies are used in the energy denominators of the reaction matrices instead of the self-consistent energies, and a second-order calculation of the true momentum density is incorporated into the equations for the system energy. If the density is computed directly with a separable potential, the equations of the theory are uncoupled. One evaluation of the new approximation, using a modification of the code used by Brueckner and Masterson, yielded an equilibrium mean energy of −14.0 Mev at 1.04 F, in good agreement with Brueckner and Gammel's −15.2 Mev at 1.02 F and with Brueckner and Masterson's −16.9 Mev at 1.00 F. All the calculations referred to employed the same hard-core phenomenological potential. Several possible future uses of the approximation are briefly discussed. (auth)

32835 DECAY OF 66-MIN $_{49}In^{110}$. T. D. Nainan, A. S. Johnston, and S. Jha (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 135: B601-4(Aug. 10, 1964).

A source of pure ^{110}In, particularly free from ^{110m}In, was made by bombarding a natural indium foil with about 100-Mev protons, and chemically separating tin (predominantly ^{110}Sn, which is the parent of only ^{110}In) from the indium target. Scintillation spectrometer studies showed that the well known 280-kev gamma ray is emitted in the decay of ^{110}Sn to ^{110}In, and the following gamma rays are emitted in the decay of ^{110}In: 656, 820, 1120, 1400, 1630, 1780, 2130, 2300, 2400, 2600, 2750, 3000, 3400, and 3650 kev. The following levels in ^{110}Cd, fed from the decay of ^{110}In, are postulated: 656, 1474, 1541, 1790, 1910, 2060, 2820, 3110, 3400, and 3650 kev. From the study of gamma rays in simultaneous coincidence with two annihilation quanta, the intensity of the positron branching to the 656-, 1474-, and 1790-kev states are estimated to be 71, 0.2, and 0.1%, respectively. The log ft to these states are calculated to be 5.5, 7.4, and 7, respectively. It is concluded that the allowed positron decay to the 1474-kev state is retarded by a factor of about 100. (auth)

32836 APPROXIMATE INDEPENDENCE OF OPTICAL-MODEL ELASTIC SCATTERING CALCULATIONS ON THE POTENTIAL AT SMALL DISTANCES. George H. Rawitscher (Yale Univ., New Haven). Phys. Rev., 135: B605-12 (Aug. 10, 1964). (TID-19508; NYO-1807-3)

In optical-model calculations of the elastic scattering of alpha particles or other heavier nuclei on nuclei, it was observed that the cross section is rather insensitive to variation of the optical potential at small values of the interaction distance. It is pointed out that in many cases this effect can be explained with the aid of the JWKB approximation. If the real part V of the optical potential V + iW is sufficiently deep and if W produces sufficient absorption, then at some point R_b contained inside the interaction region, the outgoing branch of the JWKB expression for the radial wave function becomes negligible compared to the ingoing branch. In this case the choice of the potentials for $r < R_b$ does not affect the phase shifts, and the use of an ingoing wave boundary condition applied at R_b to the radial wave function is nearly equivalent to the use of conventional optical-model procedures. Under such circumstances the phase shifts are in essence determined by the penetration of the radial wave function through the barrier formed by the combined action of the Coulomb, nuclear, and centrifugal potentials. (auth)

32837 STATISTICAL THEORY OF NUCLEAR COLLISION CROSS SECTIONS. P. A. Moldauer (Argonne National Lab., Ill.). Phys. Rev., 135: B642-59(Aug. 10, 1964).

A formalism is developed for a statistical treatment of the energy variations of nuclear scattering and reaction cross sections. A statistical collision matrix U^S is defined which has the form of an energy-independent direct-transition matrix plus a fixed simple resonance-pole expansion, the matrix residues of which are products of complex channel-width amplitudes. By direct comparison with the Wigner-Eisenbud and Kapur-Peierls collision matrices it is found that under widely applicable conditions the statistical collision matrix may be used to calculate averages of observables over energy intervals containing many resonances and many total widths. The problem of determining the statistical properties of the parameters of U^S is defined and is solved for several special cases by relating it to the statistics of R-matrix parameters. Using these methods averages and mean-square fluctuations of total and reaction cross sections are calculated under general conditions admitting direct and compound processes and arbitrary average values of the total widths Γ and the resonance spacings D. The results are expressed in terms of the direct-reaction matrix elements and the statistical properties of resonance parameters appropriate to the energy region under consideration and are related to the locally applicable optical-model phase shifts and transmission coefficients. Simplifications are obtained under special assumptions such as uncorrelated width amplitudes, small and large Γ/D, pure compound-nucleus reactions, many competing open channels, and many competing direct processes. In the limit of small Γ/D one obtains the leading terms of an expansion of the average cross section which was previously derived from R-matrix theory directly. In the limit of large Γ/D, many competing channels, but no direct reactions, the nonelastic fluctuation (or average compound nucleus) cross sections approach the Hauser-Feshbach formula. Except in this limit, corrections due to partial-width fluctuations and resonance-resonance interference are applicable. The former are sensitive to the magnitudes of direct reaction matrix elements, the latter to the correlations of resonance energies. Competing direct reactions are shown to require reductions of the transmission coefficients. The mean-square fluctuations of cross sections are found to approach Ericson's results in the limit of large Γ/D and many competing channels, but are in general much larger for moderate Γ/D and few channels. They are also sensitive to the details of resonance parameter statistics. (auth)

32838 ENERGY DEPENDENCE OF ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES BY C^{12} AND THE $C^{12}(\alpha,p)N^{15}$ REACTION. R. A. Atneosen, H. L. Wilson, M. B. Sampson, and D. W. Miller (Indiana Univ., Bloomington). Phys. Rev., 135: B660-8(Aug. 10, 1964).

Angular distributions of alpha groups corresponding to elastic scattering and inelastic excitation of ^{12}C to 4.43 Mev and of the proton group leading to the ground state of ^{15}N were measured at eight different energies between 20 and 23 Mev. The angular distributions show major changes over 400-kev energy intervals similar to those observed at higher and lower energies for the same scattering processes. The backward peaking in the $^{12}C(\alpha,p)^{15}N$ reaction is not maintained over the energy region 22 to 25 Mev, as previously thought, but decreases again at energies slightly greater than 22 Mev. (auth)

32839 FISSION-EXCITATION FUNCTIONS IN INTERACTIONS OF C^{12}, O^{16}, AND Ne^{22} WITH VARIOUS TARGETS. Torbjorn Sikkeland (Univ. of California, Berkeley). Phys. Rev., 135: B669-77(Aug. 10, 1964). (UCRL-11242)

The fission cross sections σ_f in the bombardment of Cs, Pr, Tb, Ho, ^{170}Er, Tm, ^{174}Yb, Lu, ^{182}W, Au, and Bi with ^{16}O, Tm with ^{12}C, and Tb with ^{22}Ne were measured as a function of projectile energy. The technique consists of counting coincident fission-fragment pairs with two Au surface-barrier Si detectors. The results are given in units of the total interaction cross section σ_R, and as a function of the excitation energy E of the compound nucleus. It is demonstrated that for a constant value of E for a compound nucleus σ_f/σ_R is a function of the mass of the ion used and thus of the angular momentum of the nucleus. Fission for the systems investigated takes place only for nuclei formed in a complete fusion of the ion and the target nuclei. The cross section of σ_{CF} for this process is shown

to be nearly independent of E and the target used. The ratio σ_{CF}/σ_R was found to be 0.70 and 0.45 for ^{16}O and ^{22}Ne, respectively. From the ratio σ_f/σ_{CF}, experimental Γ_f/Γ_n values are obtained and compared to theoretical ones. The following values in Mev with a standard deviation of 2 Mev for the experimental fission threshold for a nonrotating nucleus are obtained: 34.9, 26.5, 25.1, 24.6, 24.2, 20.4, 19.8, 18.2, and 17.0 for the compound nuclei ^{149}Eu, ^{157}Ho, ^{175}Ta, ^{181}Re, ^{186}Os, ^{185}Ir, ^{190}Pt, ^{191}Au, and ^{198}Po, respectively. These values, when corrected for shell effects, fit well the formula for a nonrotating charged liquid drop: $E_f^L = 6.76(0.75 - x)A^{\frac{2}{3}}$. Here, $x = (^2Z/A)/(^2Z/A)_{crit}$ and the value 48.0 ± 1.0 was obtained for $(^2Z/A)_{crit}$. The ratio between the level-density parameters for fission and neutron evaporation a_f/a_n is found to be 1.22 ± 0.05; this ratio is independent of nuclear type. In particular, the ratio is nearly the same inside and outside the region of the closed shell. Values for moments of inertia can not be evaluated from the analysis. (auth)

32840 ELASTIC SCATTERING OF 21.0-Mev DEUTERONS BY He^4. H. W. Broek and J. L. Yntema (Argonne National Lab., Ill.). Phys. Rev., 135: B678-9 (Aug. 10, 1964).

The elastic scattering of 21.0-Mev deuterons by ^4He was measured from 16 to 166°. The absolute differential cross sections are tabulated. The data show no indication for the relative maximum found near 60° at 24.85 Mev by Van Oers and Brockman. However, the cross section at the minimum near 55° is larger than the one obtained previously at lower energies. (auth)

32841 MECHANISM OF THE Si(d,p) REACTIONS BELOW 3 Mev. B. H. Wildenthal, R. W. Krone, and F. W. Prosser, Jr. (Univ. of Kansas, Lawrence). Phys. Rev., 135: B680-93(Aug. 10, 1964).

The $^{28}Si(d,p)^{29}Si$ and $^{30}Si(d,p)^{31}Si$ reactions were studied in the deuteron energy range from 2 to 3 Mev. Excitation functions for the reactions leading to various final states were obtained at 30 and 135° in the laboratory system. The differential cross sections exhibited fluctuations from 40 to 200 kev wide which were uncorrelated between the two angles of measurement and between the various final states of a nucleus. Angular distributions and the resulting total cross sections were obtained at fourteen deuteron energies. These data fluctuated significantly over short energy ranges. Plane-wave Born-approximation analysis did not give consistently correct values of l_n for $l_n > 0$. Distorted-wave Born-approximation predictions were fitted to the experimental distributions with reasonable success for the $l_n = 0$ and 1 transitions and with less conclusive results for the $l_n = 2$ transitions. The transition to the sixth excited state (3.54 Mev) of ^{31}Si was assigned the value $l_n = 1$. These theoretical predictions were used as a basis of estimating the relative importance of compound nucleus and direct-interaction reaction mechanisms in this energy range. The possibility of explaining the observed fluctuations in terms of the Ericson fluctuations of the compound-nucleus reaction component was explored. (auth)

32842 APPROXIMATION FOR THE PHASE SHIFTS PRODUCED BY REPULSIVE POTENTIALS STRONGLY SINGULAR IN THE ORIGIN. Francesco Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Phys. Rev., 135: B693-700(Aug. 10, 1964).

An approximate expression for the partial-wave scattering phase shifts produced by a potential strongly divergent at the origin is introduced. This approximation is applicable over the whole energy range; it yields the correct threshold behavior of the phase shifts and becomes exact at high energy. The high-energy behavior of the phase shifts δ_l is ascertained; as k diverges (l is fixed), $\delta_l = -Ak^{1-2/m}$, where m characterizes the behavior of the potential at the origin, $V(r) \sim r^{-m}$, $m > 2$, and A is a constant independent of l which is evaluated explicitly. Numerical tests of the accuracy of the approximation are given, including comparisons with the WKB approximation. (auth)

32843 PHOTONEUTRON CROSS SECTIONS WITH MONOENERGETIC NEUTRON-CAPTURE GAMMA RAYS. L. Green and D. J. Donahue (Pennsylvania State Univ., University Park). Phys. Rev., 135: B701-5(Aug. 10, 1964).

Monoenergetic gamma rays produced by thermal neutron capture were used to study photoneutron cross sections of the isotopes ^{181}Ta, ^7Li, ^6Li, ^{13}C, and ^{10}B for γ energies between threshold and 10.8 Mev. Some cross sections were obtained with uncertainties as low as 10%. Wherever possible, these cross sections are compared with those obtained by other methods. The threshold for the $^{181}Ta(\gamma,n)$ reaction was determined to be 7.64 ± 0.04 Mev. Information about the radiative widths of the 7.47-Mev level in ^7Li and the 8.89-Mev level in ^{10}B is presented. (auth)

32844 SCATTERING OF 22.5-Mev PROTONS FROM ZIRCONIUM AND THE SYMMETRY TERM IN THE NUCLEAR OPTICAL POTENTIAL. J. B. Ball, C. B. Fulmer, and R. H. Bassel (Oak Ridge National Lab., Tenn.). Phys. Rev., 135: B706-10(Aug. 10, 1964).

Differential cross sections for the elastic scattering of 22.5-Mev protons were measured from isotopically enriched foils of ^{90}Zr, ^{91}Zr, ^{92}Zr, ^{94}Zr, and ^{96}Zr over an angular range of 20 to 150°. The ratio to the Rutherford cross section exhibits a smooth decrease in the angular position of the maxima and minima as the mass of the target nucleus is increased. The magnitude of these shifts of the maxima and minima is larger than expected on the basis of previously observed 22.2-Mev proton elastic scattering on targets over a large range of A values. This larger shift in the angular position of the features is in agreement with a dependence of the real nuclear potential well depth on the nuclear symmetry parameter, (N-Z)/A. A detailed optical model fit to the data yields a real nuclear potential of the form, $-V = [43.4 + 27.8(N - Z)/A]$ Mev. (auth)

32845 LONGITUDINAL BEHAVIOR OF ELECTROMAGNETIC SHOWERS. Clemens A. Heusch and Charles Y. Prescott (California Inst. of Tech., Pasadena). Phys. Rev., 135: B772-8(Aug. 10, 1964). (TID-20349)

The need to establish recognition patterns for high-energy photons and electrons in cosmic-ray work, and more recently, around high-energy accelerators, has stimulated theoretical and experimental investigations into the properties of electromagnetic cascades. The most recent results of statistical computations, for longitudinal development and for lateral and angular spread, are in large part inconsistent with earlier published data. In order to study the longitudinal behavior of electron-induced showers, measurements were made with a monoenergetic electron beam (energies 100-1000 Mev). Build-up and energy dissipation were investigated, through the sampling of showers generated in lead of variable thicknesses, by means of a Lucite Cherenkov counter. Average numbers of shower particles with energies above 10 Mev are given for these incoming energies and penetration depths up to 10 radiation lengths; also, shower fluctuations

are presented for the same points. The results of this experiment can readily be compared with the data recently computed by Crawford and Messel. Agreement appears to be satisfactory. (auth)

32846 EVIDENCE FOR THE EXCITATION OF TWO-PARTICLE, ONE-HOLE CONFIGURATIONS IN THE CAPTURE OF THERMAL NEUTRONS. H. Ikegami and G. T. Emery (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 26-9(July 6, 1964).

Strengths of primary electric dipole gamma transitions to individual final states in the residual nucleus following capture of thermal neutrons by iron-54 and -56 are considered. These (n,γ) strengths are compared with the reduced strengths, or spectroscopic factors, for l = 1 (d,p) stripping on the same targets, leading to the same final states. An attempt is made to explain the observed anticorrelation between the (n,γ) strengths and the stripping spectroscopic factors. Intensities from the iron-57 (p,p') reaction are compared with the iron-56 (n,γ) strengths; results suggest similar reaction mechanisms. (M.J.T.)

32847 OFF-SHELL CORRECTION IN PION PHOTOPRODUCTION. Martial L. Thiebaux, Jr. (Stanford Univ., Calif.). Phys. Rev. Letters, 13: 29-32(July 6, 1964). (SLAC-PUB-34)

Preliminary results of analyzing pion photoproduction data by taking into account the virtuality of the exchanged pion in the Drell model are presented. It is assumed that the strong interaction within the heavy target nucleus is purely quasi-elastic and also occurs in the 3,3 resonance state. An equation for the form factor is derived, and plots of form factor vs mass are compared with experimental data from pion production in hydrogen and beryllium. The Drell angular distribution is plotted for photoproduction in beryllium from a photon spectrum with maximum energy 5.82 Bev and pion energy 5.0 Bev/c. (M.J.T.)

32848 CROSS-SECTION FLUCTUATIONS IN THE $Mn^{55}(p,\alpha)Cr^{52}$ REACTION. H. K. Vonach (Argonne National Lab., Ill.), A. Katsanos, and J. R. Huizenga. Phys. Rev. Letters, 13: 88-91(July 20, 1964).

Excitation functions of the ground state (0^+), 1.43-Mev first-excited state (2^+), and the 2.37-Mev second-excited states (4^+) in ^{52}Cr were measured for $^{55}Mn(p,\alpha)^{52}Cr$ and were analyzed in terms of the statistical fluctuations of Ericson. Errors in the fluctuation parameter, Γ, are discussed. The fluctuation amplitude R(0) for all states was found to be much larger at 170° than at other angles, and the ground-state (0^+) fluctuation amplitude at each angle was much larger than the corresponding value for each of the excited states. (L.B.S.)

32849 PRODUCTION OF NICKEL ISOTOPES IN COPPER AND OF MAGNESIUM ISOTOPES IN ALUMINUM WITH HIGH-ENERGY PARTICLES. Vitor Pereira Crespo (Centro de Estudos de Quimica Nuclear, Coimbra, Portugal). Rev. Port. Quim., 5: 6-14(1963). (In Portuguese)

Cross sections for the production of ^{65}Ni and ^{57}Ni in copper with protons at 440, 550, and 700 Mev and with alpha particles at 320, 550, and 700 Mev were measured. The cross sections for production of ^{27}Mg in aluminum by protons at 680 Mev and alpha particles at 500 and 700 Mev were also determined. It was found that the excitation function for the production of ^{65}Ni in ^{65}Cu changes drastically, whenever protons are substituted by alpha particles as bombarding particles. The results showed that, contrary to the reaction $^{65}Cu(p,p\pi^+)^{65}Ni$, the reaction $^{65}Cu(\alpha,\alpha\pi^+)^{65}Ni$ cannot be studied radiochemically. (auth)

32850 EXCITED STATES OF Cd^{112}. L. Simons (Univ. of Helsinki), K.-E. Nysten, H. Jungner, P. Holmberg, F. Stenman, and E. Hageboe. Soc. Sci. Fennica, Commentationes Phys.-Math., 28: No. 3, 1-21(1963).

The decay of ^{112}Ag was investigated through gamma-ray and coincidence spectra, by which a decay scheme agreeing with previous results was obtained. Angular correlation measurements of five gamma-gamma cascades give the following spin values: 620-kev level 2^+, 1230-kev 0^+, 1310-kev 2^+, 2250-kev 2 or 4, 2440-kev 2, and 2740-kev 1 or 3. The 1230-kev 0^+ level, which now is very well established, is found to be the 0^+ gamma-vibrational level in ^{112}Cd. (auth)

32851 NUCLEON CLUSTERING. V. E. Bunakov. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 14-20(1964). (In Russian)

A relation between the nucleon clustering and the form of the shell-model wave function of a nucleus is considered. A large class of effective two-body interactions is shown to cause clustering. An experimental regularity is found to be present in the values of binding energies of light nuclei, which assumes the existence of two-, three- and four-nucleon clusters. The method under consideration makes it possible to treat pairing, triple, and quadrunucleon correlations on the basis of the same effective two-body interactions of nucleons. A transparent physical interpretation is given for the experimental facts of energetical advantage of states with the lowest seniority and isotopic spin. (auth)

32852 DECAY OF Sb^{125}. N. M. Anton'eva and G. S. Katykhin. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 53-9(1964). (In Russian)

The β-spectrum and the spectrum of conversion electrons of ^{125}Sb was studied with the help of the coetron type magnetic spectrometer [$(\Delta H\rho/H\rho) = 0.5\%$], and a magnetic spectrograph with photographic recording [$(\Delta H\rho/H\rho) = 0.15\%$]. Data on the ^{125}Sb decay were obtained. (auth)

32853 SEPARATION AND IDENTIFICATION OF THE PRODUCTS OF GERMANIUM SPALLATION BY HIGH ENERGY PROTONS. A. N. Murin, S. B. Tomilov, and I. A. Yutalandov. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 105-10(1964). (In Russian)

A germanium target was irradiated with 660-Mev protons. The spallation products were separated by ion-exchange chromatographic methods. Identification of isotopes and check of radiochemical purity of separated fractions was carried out by means of a gamma spectrometer. A 145-kev γ line found in the zinc fraction was ascribed to ^{72}Zn. (auth)

32854 THE RELATIVE QUADRUPOLE MOMENTS OF THE FIRST EXCITED 2^+ STATES OF ^{188}Os, ^{190}Os, AND ^{192}Os. H. Spehl (Universität, Freiburg i. B.). Z. Physik, 179: 482-95(1964). (In German)

The angular distributions of the de-excitation γ rays following Coulomb excitation of the first-excited 2^+ states in ^{188}Os, ^{190}Os, and ^{192}Os were measured using a metallic target of natural osmium. The measured attenuation coefficients were $G_2(^{188}Os) = 0.798 \pm 0.013$, $G_2(^{190}Os) = 0.917 \pm 0.030$, and $G_2(^{192}Os) = 0.940 \pm 0.030$. As a general test the angular distribution of the 330-kev γ rays of ^{194}Pt was also measured. This distribution was found to be completely undisturbed. Assuming pure electric quadrupole interaction with the internal crystalline fields an interaction frequency of $\Delta\nu_Q = eQV_{zz}/h = 278 \pm 32$ MHz for the 155-kev state of ^{188}Os was obtained. Because the electric field gradients acting on the decaying nucleus were the same for all isotopes, the ratio of the quadrupole moments of the

excited states could be deduced. The result was $Q(^{188}Os)$: $Q(^{190}Os) = 1.11^{+0.28}_{-0.19}$ and $Q(^{190}Os) : Q(^{192}Os) = 1.03 \pm 0.30$. The effects of the uncertainties in the effective field gradients and their possible asymmetries on the integral attenuation factors are discussed. For $1 \geq G_2 \geq 0.75$ these effects were found to be small. (auth)

32855 MEASUREMENT OF FIVE β-γ CIRCULAR POLARIZATION CORRELATIONS IN THE DECAY $^{152}Eu \rightarrow ^{152}Gd$. W. Collin, H. Daniel, and H. Schmitt (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 179: 528-31(1964). (In German)

In the decay $^{152}Eu \rightarrow ^{152}Gd$ five β-(circularly polarized γ) correlations were measured. The Fermi matrix element of the $3^- - 3^-$ β transition was small or vanishing. The levels of 344 and 755 kev ($I = 2^+$ and 4^+, respectively) seemed to be collective states. (auth)

32856 ENERGY DISTRIBUTION AND INTERACTION CROSS SECTIONS OF THE PHOTOPROTONS FROM ^{15}N. R. Kosiek (Universität, Heidelberg). Z. Physik, 179: 544-55(1964). (In German)

The energy spectra of photoprotons from highly enriched ^{15}N were investigated with the bremsstrahlung from the Heidelberg betatron running at six different endpoint energies between 19 and 30.5 Mev. The protons were detected at 90° to the γ beam by means of a CsI spectrometer with pulse shape discrimination. The energy spectra showed pronounced maxima at $E_p = 3.2$; 4.6; 9.5; and 13.3 Mev. Proton yields are given as a function of endpoint energy, the yield value $E_0 = 30.5$ Mev being (7.0 ± 0.8) μb/Mev · ster. Because the first excited state in the daughter nucleus ^{14}C lies 6.09 Mev above the groundstate, the cross section for groundstate transitions of the process $^{15}N(\gamma,p)^{14}C$ could be derived from the upper 6 Mev of the single proton spectra. The main contribution to the cross section comes from the region between 18 and 26 Mev excitation energy with maxima at 19.5; 20.4; 22.7; and 24.5 Mev. A "pygmy resonance" occurs at 15.2 Mev with further less pronounced structures at 13.6 and 17.0 Mev. The integrated cross section for groundstate transitions up to 30.5 Mev is (22 ± 3) Mevmb assuming isotopic angular distribution. The ratios of protons from transitions to excited states and from the (γ,np)-reaction to those of groundstate transitions rise from 0.45 at $E_0 = 24.5$ Mev to 0.70 at $E_0 = 30.5$ Mev. (auth)

32857 THE DENSITY DISTRIBUTION IN THE ATOMIC NUCLEUS ACCORDING TO THE DROP MODEL. D. Drechsel and W. Scheid (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 179: 556-60(1964). (In German)

The density distribution in atomic nuclei was calculated from the drop model, taking the zero-point oscillations of the nuclear surface into account. The resultant density parameters t, c, and R_{eq} were consistent with elastic electron scattering and meson (μ) experiments. (auth)

32858 REACTIONS (d,α) ON ^{11}B AND ^{16}O AT A DEUTERON ENERGY OF 6.6 Mev. K. A. Gridnev, A. E. Denisov, Yu. A. Nemilov, V. S. Sadkovskii, and E. D. Teterin. Zh. Eksperim. i Teor. Fiz., 46: 1473-4(Apr. 1964). (In Russian)

An attempt was made to determine which reaction mechanism — direct or compound nucleus — predominates in the (d,α) reaction on light nuclei at medium energies, i.e., 5 to 8 Mev. Alpha angular distributions from the reaction $^{11}B(d,\alpha)^9Be$ are presented for the fundamental and the second excited states of ^9Be. The differential cross sections for these levels have a similar appearance at 90° and small absolute values, indicating a compound-nucleus mechanism. Cross-section curves for the fundamental and first excited states of ^{14}N in the $^{16}O(d,\alpha)^{14}N$ reaction increase sharply toward 180°. The curves may be represented as a sum of a Legendre polynomial at low angles and a peak in the backward angle region, i.e., as the result of intense compound-nucleus processes and alpha-particle distortion by the target nucleus. (M.J.T.)

32859 REACTIONS (p,pn) AND (p,n) ON ^{45}Sc UNDER THE ACTION OF HIGH-ENERGY PROTONS. De-khou Zhen, I. Levenberg, V. Pokrovskii, L. Tarasova, and I. Yutlandov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1475-6(Apr. 1964). (In Russian)

Continuing experiments on the radiochemical study of simple nuclear reactions in a bombarding-proton energy range of the order of 100 Mev are reported. Cross sections of the (p,pn) and (p,n) reactions on ^{45}Sc, the ratio of the formation cross sections of ^{44g}Sc and ^{44m}Sc, and cross sections of the monitor reaction $^{27}Al(p,3pn)$ are given for seven proton energies from 120 to 670 Mev. For comparison cross sections of the reactions (p,pn) and (p,n) on ^{48}Ca are presented. Comparison with theory confirms the hypothesis that the principal reaction mechanism is one of direct knock-out. (M.J.T.)

32860 MULTIPOLARITY OF THE TRANSITION ISOMERIC IN THE NUCLEUS $_{58}Ce^{138}$. Yu. N. Rakivnenko, E. A. Skakun, G. I. Yatsenko, and A. P. Klyucharev. Zh. Eksperim. i Teor. Fiz., 46: 1476-7(Apr. 1964). (In Russian)

A study was made of the decay of the ^{138}Ce metastable state formed in the reaction $^{139}La(p,2n)^{138m}Ce$ at 20 Mev. The half life was found to be about 9.2 ms, and the excitation energy 2.14 Mev. The spectrum of electrons of internal conversion for the ^{138}Ce isomeric transition is presented, and the transition energy is found to be 301 ± 1 kev, in agreement with previous experiments. Comparison with calculations gives the transition as E3. The fundamental state of the even-even nucleus ^{138}Ce has zero spin and positive parity; the 2.14-Mev isomeric level has spin 7 and negative parity. The decay scheme of ^{138m}Ce, corresponding to these deductions, is given. (M.J.T.)

32861 ON THE PERIODS OF HALF-DECAY OF THE GROUND AND ISOMERIC STATES OF ^{174}Lu. V. A. Balalaev, B. S. Dzhelepov, A. I. Medvedev, A. Meshter, and I. F. Uchevatkin (Mendeleev All-Union Inst. of Metrology, [Academy of Sciences,] USSR). Zh. Eksperim. i Teor. Fiz., 46: 1478(Apr. 1964). (In Russian)

Experiments were performed to measure the electron conversion spectra of ^{173}Lu and ^{174}Lu in the energy range 540 to 1450 kev, using beta spectrometry. It was found that the ground state of ^{174}Lu decays with a half life of 1300 days and the isomeric state, with a half life of 140 days. The 1243 kev transition is excited from the ground state and the 994 kev transition from the isomeric state. (M.J.T.)

32862 γ TRANSITIONS AT HIGH ENERGIES IN THE DECAY OF ^{72}Ga. V. D. Vitman, B. S. Dzhelepov, and Yu. N. Podkopaev (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1479-80(Apr. 1964). (In Russian)

The gamma spectrum of ^{72}Ga in the energy range 3 to 4.5 Mev was investigated using gamma scintillation spectrometry. The obtained spectrum and the intensities of four transitions are presented. (M.J.T.)

32863 THE EMISSION OF PHOTOPROTONS FROM CALCIUM. B. S. Ratner. Zh. Eksperim. i Teor. Fiz., 46: 1480-1(Apr. 1964). (In Russian)

The emission of photoprotons with energies greater

than 5 Mev was measured as a function of the gamma energy in the reactions $^{40}Ca(\gamma,p$ and $\gamma,pn)$ for gamma energies up to 27 Mev. Exact measurements in the region of the gigantic resonance show two maxima at photon energies of 19.0 and 19.9 Mev. Cross sections for photoproton emission were calculated for proton energy above 5 Mev. (M.J.T.)

32864 SPIN OF THE 1360-kev LEVEL IN THE NUCLEUS ^{150}Sm. V. Kozhokaru and M. Petrashku. Zh. Eksperim. i Teor. Fiz., 46: 1481-3(Apr. 1964). (In Russian)

Since the 1360 → 774 kev transition is E1 and the spin of the 774 kev level is 4, the 1360-kev level spin must be 3, 4, or 5 and the parity negative. Angular correlations of γ quanta from the 585–440 kev cascade, following fast neutron capture by ^{149}Sm, were measured. Theoretical correlation functions with geometrical corrections are presented for the three possible spin values and compared with the experimentally obtained value. Agreement with experiment is achieved by representing the cascade as 4 → 4 → 2. Ratios of the theoretical correlation functions at 135 and 90° and at 180 and 90° agree with calculations from the experimental data. Thus the spin of the ^{150}Sm 1360-kev level is determined to be 4. (M.J.T.)

32865 REACTIONS (n,2n) ON ^{112}Sn, ^{124}Sn AND (n,p) ON ^{112}Sn, ^{117}Sn AT 14.1 Mev. A. P. Klyucharev, V. V. Ushakov, and G. P. Chursin. Zh. Eksperim. i Teor. Fiz., 46: 1483-4 (Apr. 1964). (In Russian)

A comparison was made of experimental and theoretical results for (n,p) and (n,2n) reactions for the case of Z = 50. Cross sections were measured by the method of induced beta activity, using ^{63}Cu (n,2n) and ^{27}Al (n,p) reactions as calibration. (M.J.T.)

32866 PHOTOPROTONS FROM CALCIUM. B. S. Ishkhanov, I. M. Kapitonov, E. N. Kornienko, V. G. Shevchenko, and B. A. Yur'ev. Zh. Eksperim. i Teor. Fiz., 46: 1484-6(Apr. 1964). (In Russian)

Angular and energy distributions of photoprotons from calcium-40 were measured to a maximum photon energy of 22 Mev, using the photodisk technique. Cross sections for the reaction were obtained for photon energy maxima from 14.5 to 32.5 Mev, with the aid of scintillation spectrometers. For four proton energy intervals, the position of maximum emission and the cross section at this maximum are given. It is indicated that either there is one dipole level or there are two close levels in ^{40}Ca lying near 20 Mev. (M.J.T.)

32867 RESONANCE SCATTERING OF γ-QUANTA ON ^{140}Ce NUCLEI. R. B. Begzhanov and A. A. Islamov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Zh. Eksperim. i Teor. Fiz., 46: 1486-8(Apr. 1964). (In Russian)

Resonance scattering by ^{140}Ce of 1597-kev gamma rays, emitted in the decay of ^{140}La to ^{140}Ce, was investigated. Radiation scattered from both solid and liquid sources and reflected by CeO_2 and BaO targets was measured; the intensity differences from the two different targets gave the net scattering from ^{140}Ce. The average scattering cross section was obtained. The lifetime of the 1597-kev excited state in ^{140}Ce was determined in a second experiment. (M.J.T.)

32868 CROSS SECTION FOR THE REACTION $^{13}C(\gamma,p)^{12}B$. V. P. Denisov, A. V. Kulikov, and L. A. Kul'chitskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1488-90(Apr. 1964). (In Russian)

Emission in the reaction $^{13}C(\gamma,p)$ was investigated by the beta activity of the final nucleus. Differential cross section curves are given for energies up to 50 Mev. The energies of several peaks and their integral cross sections are presented. Results are compared with those from two other experiments—on photoproton production on carbon-13 and on carbon-12—and from theoretical calculations. (M.J.T.)

32869 RADIATION OF ^{100}Pd. N. M. Anton'eva, M. K. Nikitin, and V. B. Smirnov (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1490-2(Apr. 1964). (In Russian)

Radiation of ^{100}Pd was investigated using magnetic, gamma scintillation, and total gamma absorption spectrometry. Spectra of conversion electrons and gamma transitions are presented. Energies of especially intense lines are tabulated. Half lives of ^{100}Pd and ^{100}Rh are obtained, and a decay scheme is given. (M.J.T.)

32870 INVESTIGATION OF THE REACTION (γ,p) ON CARBON. G. G. Taran and A. N. Gorbunov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1492-4(Apr. 1964). (In Russian)

The reaction (γ,p) on carbon was investigated at bremsstrahlung energies to 170 Mev, using a Wilson cloud chamber in a magnetic field. Cross sections for (γ,p) and (γ,pn) reactions are given and compared with previously determined differential cross sections for 76°. The positions and integral cross sections of two peaks in the (γ,p) reaction between 30 and 37 Mev agree with values for a predicted dipole level. The integral cross section from threshold to 170 Mev is obtained. (M.J.T.)

32871 POLARIZATION OF NEUTRONS IN THE REACTIONS $^{11}B(d,n)^{12}C$, $^{12*}C$. V. A. Smotryaev and I. S. Trostin (Inst. of Theoretical and Experimental Physics, [Academy of Sciences,] USSR). Zh. Eksperim. i Teor. Fiz., 46: 1494-5(Apr. 1964). (In Russian)

Results of measurements of neutron polarization in the reaction $^{11}B(d,n)^{12}C$ for the ground and first excited states of ^{12}C are presented. The average deuteron energy was 9.3 Mev. Polarization was determined by the azimuthal asymmetry of neutron scattering on ^4He. (M.J.T.)

32872 TOTAL NEUTRON CROSS SECTIONS FOR ISOTOPES OF LEAD. Yu. V. Dukarevich, A. N. Dyumin, and D. M. Kaminker (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1496-7 (Apr. 1964). (In Russian)

Total neutron interaction cross sections for $^{204,206-8}Pb$, ^{209}Bi, and Tl were measured for 14.2-Mev neutrons. The dependence of the total cross section on the mass number of the isotope is given. Results are compared with those from previous experiments on proton and alpha scattering from the same isotopes. (M.J.T.)

32873 PHOTONEUTRONS FROM ^6Li AND ^{59}Co. E. B. Bazhanov, A. P. Komar, and A. V. Kulikov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1497-9(Apr. 1964). (In Russian)

Cross sections of photoneutron reactions on ^6Li and ^{59}Co were investigated, using BF_3 counters to record the thermalized neutrons. A histogram of the dependence of the ^6Li photoneutron cross section on gamma energy to 60 Mev is presented and compared with values from a previous experiment. The excitation function of photoneutron reactions on ^{59}Co is given and compared with other experimental and theoretical values. Integral cross sections are obtained for both nuclides. (M.J.T.)

32874 NUCLEAR PHYSICS. AN INTRODUCTION. W. E. Burcham. New York, McGraw-Hill Book Company, Inc., 1963. 753p. $12.00.

Facts and theories of nuclear physics are described from an experimental standpoint. Natural radioactivity, wave mechanical theory of atoms, techniques in nuclear physics, nuclear properties and reactions, and neutron-proton interactions are discussed. (R.E.U.)

32875 CHARGE STATES OF FAST CARBON IONS. R. L. Wolke and V. J. Sodd (Univ. of Pittsburgh). p.700-8 of "Atomic Collision Processes." Amsterdam, North-Holland Publishing Co., 1964. (TID-20034)

The equilibrium charge-state distributions of ^{12}C ions with velocities between 8.77 and 9.77×10^8 cm/sec and of ^{13}C ions with velocities between 7.08 and 8.46×10^8 cm/sec were determined. The ions were produced as recoils from $^{12}C(d,d')$ and $^{12}C(d,p)$ reactions induced by 15-Mev deuterons, equilibrated during the process of escaping from the carbon targets, subjected to magnetic analysis, and detected with a low-resistivity Si surface-barrier detector. The data join smoothly to previous results, which are predominately at higher velocities. (auth)

32876 STUDY OF NUCLEAR STRUCTURE BY MEANS OF THE (n,γ) REACTION. N. Fiebiger. p.125-38 of "Physikertagung Stuttgart 1963." Mosbach/Baden, Ger., Physik Verlag. (In German)

The capture of low-energy neutrons in a nucleus is considered as the classical example for the formation of a compound system. Before reporting some experimental results on (n,γ) reactions, a brief survey is given of the measurement techniques used. Only the capture of neutrons with $E_n < 2$ kev is considered. Experimental results on the radiation width of the primary gamma, the fluctuations of the partial radiation width, the spectral distribution of the gammas, and the capture mechanisms are reviewed. (J.S.R.)

32877 NUCLEAR STRUCTURE STUDIES IN THE MOLYBDENUM ISOTOPES WITH (d,p) AND (d,t) REACTIONS. Sven A. Hjorth and Bernard L. Cohen (Univ. of Pittsburgh). 52p. (CONF-452-4)

From American Physical Society, Washington, D. C., Apr. 1964.

Many new energy levels are located in the odd-A molybdenum isotopes, and spin and parity values are assigned. It was found that the ground state spins of ^{99}Mo and ^{101}Mo are both $\frac{1}{2}^+$. Occupancy numbers and relative single quasiparticle energies for the $2d_{\frac{5}{2}}$, $3s_{\frac{1}{2}}$, $1g_{\frac{7}{2}}$, and $2d_{\frac{3}{2}}$ single quasiparticle states are obtained. The single quasiparticle energies for ^{93}Mo, which are equal to the single-particle energies because ^{92}Mo forms a closed shell, differ only little from those in the isotone ^{91}Zr. In spite of this, the quasiparticle energies are much lower and the mixing much stronger in the more neutron-rich molybdenum isotopes than in the corresponding zirconium isotopes. A pairing force calculation revealed that the comparatively small shift in the single-particle levels between zirconium and molybdenum could not account for this completely different behavior of molybdenum and zirconium. (auth)

32878 DECAY OF 12-MINUTE Nd^{151}. R. V. Mancuso and R. G. Arns (State Univ. of New York, Buffalo). 19p. (CONF-452-9)

From American Physical Society, Washington, D. C., Apr. 1964.

Sources of ^{151}Nd were prepared by irradiating NdO_2, enriched to 95% in ^{150}Nd, in a reactor flux of 10^{12} to 10^{13} $n/cm^2/sec$ for periods of two to three minutes. The gamma rays of ^{151}Pm, following the ^{151}Nd beta decay, were studied with a scintillation coincidence spectrometer. Prominent energies in the gamma spectrum are 85, 115, 130, 170, 255, 417, 575, 661, 735, 855, 995, 1085, 1115, 1170, 1310, 1540, 1723, and 2070 kev. Clear coincidences are observed between gamma rays of 130, 417, 735, 995, 1170, and 1723 kev and the 115-kev transition, and also between gamma rays of 252, 661, and 1115 kev and the 170-kev transition. In addition, the 575-, 855-, and 1085-kev gamma rays are in coincidence with the 255-kev transition. Other coincidence measurements are discussed. A decay scheme consistent with the data is proposed. The prominent energy levels are 115, 170, 245, 255, 422, 532, 831, 850, 1110, 1285, 1340, 1838, and 2070 kev. Evidence for additional, weakly-fed levels is presented. (auth)

32879 NUCLEAR SPIN-LATTICE RELAXATION IN PARAMAGNETICALLY DOPED CaF_2 AT 77°K, 90°K, AND 195°K. Ronald A. Laing and Jean Cass (Tulane Univ., New Orleans). 9p. (CONF-531-7)

From American Physical Society 1964 Southwestern Meeting, Tucson, Ariz., Feb. 1964.

The spin-lattice relaxation time of ^{19}F nuclei in pure and MnF_2-doped CaF_2 is measured as a function of magnetic field, orientation, and temperature. It is concluded that the relaxation in the pure crystals is diffusion-limited and that in the doped crystals is of the rapid-diffusion type. (T.F.H.)

32880 DIRECT REACTIONS AND NUCLEAR STRUCTURE. N. Austern. 15p. (CONF-396-8)

From Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Mar. 1964.

The competition between compound-nucleus (CN) and direct-interaction (DI) processes in nuclear reactions is analyzed, and factors helping or hindering each of the processes are discussed. The distorted-wave Born approximation for DI processes is developed. (T.F.H.)

32881 NUCLEAR STRUCTURE STUDIES WITH (d,p) AND (d,t) REACTIONS. Bernard L. Cohen (Univ. of Pittsburgh). 15p. (CONF-396-9)

From Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Mar. 1964.

The uses of (d,p) and (d,t) reactions as tools for analyzing the locations of nuclear single-particle (SP) states, the locations of single-quasi-particle states, the degree of filling of SP states, the distribution of components of SP states, neutron binding energies, and spectra of odd target nuclei are described. (T.F.H.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 32321 and 32521.

32882 (A/CONF.28/P/195) CONTROLLED FUSION RESEARCH IN THE U.S.A. A. H. Snell (Oak Ridge National Lab., Tenn.), L. Spitzer, J. L. Tuck, and C. M. Van Atta. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of magnetic-mirror, Astron, and toroidal containment studies; DCX-1, DCX-2, electron-cyclotron-heating, and electron-beam–plasma interaction studies; development and operations of the Scylla IV theta-pinch and Stellarator devices; and various other related plasma studies. (T.F.H.)

32883 (AFCRL-63-782(Vol.III)) INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME III. EXPERIMENTS. Final Report. C. D. Joerger (McDonnell Aircraft Corp., St. Louis). Nov. 30, 1963. Contract AF19(628)-239. 179p. (A-219(Vol.III); AD-429154)

The investigation of factors influencing the creation, propagation, and detection of a type of magnetohydrodynamic wave, the Alfven wave, that can exist in a partially ionized, low density medium is discussed. The theoretical aspects of MHD waves, as might be generated under ionospheric conditions and excited in a simulated environment, are covered in Volume II. This report describes the experimental design and subsequent test results of wave propagation experiments in three plasma facilities: a hypervelocity impulse tunnel; an electromagnetic shock tube; and an arc discharge tube. Volume I of this series provides a brief summary of Volumes II and III. (auth)

32884 (CEA-R-2502) PLASMOIDES À HAUTE FRÉQUENCE ET DÉCHARGES RÉSONNANTES (THÈSES). (High-Frequency Plasmoids and Resonant Discharges (thesis)). Joseph Taillet (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 120p.

Submitted to Paris. Université.

In r-f discharges at reduced pressure a resonance can increase by an order of magnitude the intensity of the plasma r-f electric field. The electron density of the plasma adjusts itself to keep the resonant frequency equal to the excitation frequency. This behavior was observed by an electron beam technique. When such a discharge is excited in electronegative gases, the negative ion density may be higher than the electron density. Therefore, the d-c potential distribution in plasma and sheath is modified. The plasma appears as a luminous body isolated from the walls by a large sheath (r-f plasmoid). (auth)

32885 (D1-82-0332) TWO-STREAM INSTABILITY IN A FINITE LENGTH. Richard Gerwin and Donald J. Nelson (Boeing Scientific Research Labs., Seattle). Mar. 1964. 50p.

A study is made of two contra-streaming electron beams of equal densities and speeds interacting between two parallel planes. The streams are cold and their average charge is compensated by a uniform positive background. For infinitely broad streams, an eigenfrequency equation is derived from the conditions that the entering beams be free of perturbations. The eigenfrequency equation is solved numerically and the results show there is no instability for $\omega_b\tau < \pi/2^{\frac{1}{2}}$, where ω_b is the plasma frequency of either beam, and τ is half the transit time between the plates. For large values of $\omega_b\tau$, the fastest-growing modes have a growth rate of $\omega_b/2$. The growth rate is also calculated from the dispersion relation assuming appropriate real values of wavenumber and is in good agreement with the exact results of the eigenfrequency equation. In view of the close correspondence between the results of the dispersion relation and the eigenfrequency equation for infinitely broad streams, a dispersion relation for thin cylindrical beams is derived and is used to estimate the critical value of $\omega_b\tau$ above which instability occurs. In the limit where beam radius is much smaller than a wavelength, the dispersion relations for infinitely strong axial applied magnetic field and zero applied magnetic field coincide. They are applied to a case where beam radius is $\frac{1}{2}$ mm, interplate spacing is 2 cm, and it is shown that the critical value of $\omega_b\tau$ is about eleven times larger than for the case of the other modes trapped inside the beam, which have the same dispersion relation as that of infinitely broad streams. (auth)

32886 (D1-82-0339) SOME NONLINEAR PROPERTIES OF ELECTRON-HOLE PLASMAS SUSTAINING THE HELICAL INSTABILITY. Betsy Ancker-Johnson (Boeing Scientific Research Labs., Seattle). Apr. 1964. 36p.

Electron-hole plasmas in p-InSb are driven far beyond the threshold of the helical instability into the nonlinear region by applying axial magnetic fields B much greater than the threshold fields B_{th}. While the plasma is immersed in a static B three fundamental properties of the plasma, namely the electric field strength E sustained in the plasma, the self magnetic field B_h produced by the rotating plasma, and the frequency of helical oscillations f, are measured. As B is increased from zero, E first decreases until $B = B_{th}$; then E rises with a slope and magnitude greater than those associated with the decrement. The quantity (B_hR/I_T), where I_T = total current and R = radius, possesses a maximum as a function of BR. At constant I_T, f exhibits a trend to increase with increasing penetration into the nonlinear region until the onset of turbulence. Between this limit and the instability threshold as many as three modes, defined by their distinct frequency ranges, are observed. The transition from one mode to another as B is varied occurs in three ways: (a) a very abrupt change even producing, in successive pulses, oscillations at two frequencies that are not harmonics while the operating conditions are held constant; (b) a gradual mixing of frequencies or, (c) a broad transition through a turbulent region. The latter transition can produce an apparently homogeneous plasma at a $B \approx 2B_{th}$. While the plasma is immersed in a time-varying magnetic field $\dot{B}$, E is measured. The most striking result is the splitting of the B_{th} into two branches with increasing $\dot{B}$ as observed by the occurrences of two minima in the E versus time curves. Comparisons are made among all these results and those available on the nonlinear properties of electron-ion plasmas, both experimental and theoretical. (auth)

32887 (D1-82-0347) CLASSIFICATION OF MEDIA. Paul Rolland (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay and Boeing Scientific Research Labs., Seattle). May 1964. 16p.

The paper of Polovin does not clarify all the difficulties in the theory of Sturrock. A complete connection is established between the theory of Sturrock and the analytical method developed by the present writer. It is shown that for the absolute instability, the demonstration of Polovin has to be completed to avoid an ambiguity. For evanescence, the boundary conditions introduced by Polovin must not be independent, so that some root gives a zero contribution; for absolute instability, it would be impossible to introduce any boundary conditions. (auth)

32888 (EUR-1644.e) SOME PROPERTIES OF A HIGH-CURRENT SPARK GAP. P. C. T. Van der Laan and A. De Jong (Stichting Voor Fundamenteel Onderzoek der Materie. Institutt Voor Plasma-Fysica, Jutphaas, Netherlands). 1964. 14p.

A triggered spark gap in air of atmospheric pressure was developed for use in a condenser bank. The spark gap switches a group of condensers with a total capacity of 31 μf and an energy of 5 kj at a maximum voltage of 18 kv. To obtain reliable parallel operation of several spark gaps over a wide voltage range a study was made of the delay of and the jitter in the moment of breakdown.

From the measurements, the conclusion could be drawn that in the voltage range in which the jitter is small, breakdown is initiated in the region of enhanced field in front of the trigger pin. Measurements of the spread in the spontaneous breakdown voltage at high currents showed that brass is a suitable material for the electrodes and the trigger pin. (auth)

32889 (LA-3078) EXPERIMENTAL STUDIES OF A CROSSED-FIELD PLASMA ACCELERATOR. D. A. Baker and J. E. Hammel (Los Alamos Scientific Lab., N. Mex.). Apr. 1, 1964. Contract W-7405-eng-36. 34p.

A linear plasma accelerator based on crossed electric and magnetic fields was studied. Experiments were performed with neutral gas or with plasma from a coaxial gun injected between the parallel-plate electrodes of the device. In both cases the velocity of the emergent plasma stream could not be made to exceed ~5 cm/μsec. Attempts to raise the stream velocity by increasing the electrode supply voltage resulted only in the production of a higher density stream traveling at the same limiting value of velocity. The dense ($n > 10^{15}$ cm^{-3}) stream emerging from the electrode region was only slightly diamagnetic, and it moved across the transverse magnetic field by means of an $\vec{E} \times \vec{B}$ drift in which $\vec{E}$ is a polarization electric field produced by charge separation in the plasma. It was found that the forward drift of the stream could be stopped by conducting plates located to the side of the stream to drain off the polarization charge. The measurement of the depolarization current yields a new method of determining the stream momentum flow. (auth)

32890 (LAMS-3086) EXPERIMENTAL OBSERVATION OF A CESIUM PLASMA DIODE WITH A NICKEL EMITTER. Walter H. Reichelt (Los Alamos Scientific Lab., N. Mex.). May 1964. Contract W-7405-eng-36. 26p.

A variable spacing cesium plasma diode was equipped with a nickel emitter and used to investigate cell characteristics when the cell was operated in a driven, low-voltage discharge mode. Current densities, electron temperatures, and ion densities were determined as a function of cesium pressure, cell spacing, etc. Emitter temperatures were in the vicinity of 1000°K since the data were intended for use in plasma propeller experiments. (auth)

32891 (NP-14071) VZAIMODEISTVIE PLAZMENNYKH SGUSTKOV S AKSIAL'NO-SIMMETRICHIYM MAGNITNYM POLEM. II. (Interaction of Plasma Bunches with Axially Symmetric Magnetic Field. II). Yu. S. Azovskii, I. T. Guzhovskii, Yu. P. Mazalov, and V. P. Pistryak. VZAIMODEISTVIE PLAZMENNYKH SGUSTKOV S AKSIAL'NO-SIMMETRICHIYM MAGNITNYM PROBLEM. III. (Interaction of Plasma Bunches with Axially Symmetric Magnetic Field. III). Yu. S. Azovskii, R. V. Akhmerov, I. T. Guzhovskii, Yu. P. Mazalov, and V. P. Pistryak (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). 1963. 21p.

Reactions of dense plasma bunches with axially-symmetric heterogeneous magnetic field were studied, and the variations of induced current and its field, radius, and density, and bunch acceleration were determined. Preliminary measurements showed that under given conditions the bunch diffusion is not abnormally fast. (R.V.J.)

32892 (NP-14('SSLEDOVANIE STATSIONARNOI ARGONO-TSEZII. ZMY S NERAVNOVESNOI PROVODIMOST'YO. (Investigation of a Stationary Argon–Cesium Plasma with a Non-Equilibrium Conductivity). V. S. Golubev, G. A. Kasabov, and V. F. Konakh (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 38p.

Various methods were used for determining the parameters of argon–cesium plasma at argon pressures of 20 to 240 mm Hg and cesium pressures of 10^{-4} to 10^{-1} mm Hg. With gas temperature (600 to 800°K) lower than electron temperature (2000 to 3000°K) nonequilibrium conductivity was observed. The conductivity was calculated using electron scattering energy losses and electron–atom collision frequencies. Comparisons of argon–cesium, helium–cesium, pure argon, and pure cesium plasmas indicated that the argon–cesium plasma would be most efficient for MGD transformers with nonequilibrium conductivity. (tr-auth)

32893 (ORNL-3652) THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1964. (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 172p.

Developments in thermonuclear research are reported in eleven sections, ten of which have been abstracted separately. The remaining section deals with the design of a vacuum seal and lock, measurements of the friction factors for water flowing in curved Cu conductors, and analyses of the engineering implications of proposed thermonuclear reactors. (T.F.H.)

For abstracts of individual chapters see: 31743, 32275, 32321, 32894, 32895, 32896, 32897, 32898, 32899, and 32900.

32894 (ORNL-3652(p.1-27)) DCX-1 PLASMA EXPERIMENTS. J. L. Dunlap, R. S. Edwards, G. R. Haste, L. A. Massengill, C. E. Nielsen, H. Postma, L. H. Reber, R. G. Reinhardt, W. J. Schill, and E. R. Wells (Oak Ridge National Lab., Tenn.).

Investigations of plasmas established by Lorentz-force trapping at very low pressures indicate that the measured charge-exchange loss is less than the proton input current. This discrepancy does not appear to be the result of instrumental effects, of axial expansion into the coil throats or out of the mirrors, or of radial losses due to slow radial diffusion. Rapid radial transport or a combination of radial and axial scattering to the side walls of the high-vacuum region are suspect and are being examined, as well as the possibility that the trapping rate is not constant. Experiments with movable end walls of both tuned and grounded configurations showed no stabilization against fast-proton scattering, but did show that under some conditions the unstable longitudinal mode could be made to completely dominate. Panoramic data of the radio-frequency signals from this mode led to a theory which indicates that this instability is the result of electrostatic coupling of proton axial oscillation waves with trapped electrons. Studies of low-frequency oscillations were made by using electrostatic probes. It was not possible to arrive at a consistent interpretation of this phenomenon as a simple azimuthally revolving disturbance. The data suggest that the signals may arise from a set of oscillators (possibly involving only slow plasma components) in azimuthal rotation at different frequencies. Calculations of the radial distribution of initially trapped protons and studies of gas desorption by energetic electron bombardment are described. (auth)

32895 (ORNL-3652(p.28-38)) DCX-2. P. R. Bell, L. J. Bledsoe, J. S. Culver, et al. (Oak Ridge National Lab., Tenn.).

Experiments in DCX-2, using a lithium arc for dissociation, have produced plasmas with densities in excess of

10^{10} ions/cm^3 over a volume of 100 liters. The mean energy of the trapped plasma is as high as 1.0 Mev under some conditions. Improved diagnostics, especially a current integrator for the charge-exchange flux following beam turnoff, permit continuous monitoring of the plasma density as a function of parameter changes. The magnetic field adjustment has been found to be particularly critical. Use of the lithium arc for dissociation has resulted in as much as 90% dissociation of the 600-kev molecular ion beam. Particle and power accountability studies lead to the conclusion that five-sixths of the injected protons are lost to the snout; only one-sixth are lost by charge exchange at the highest density. The angular distribution (relative to the plane perpendicular to the axis) of the emitted charge-exchange flux shows a peculiar peak at 0° (present only at high densities) and side lobes at the injected pitch angle. It appears that the long decay times (≤0.1 sec) and high density are associated with these particles, trapped by small mirrors in the central field, which prevents them from reaching the snout. Monitoring of the radio frequency has shown a shift in time following beam turnoff of the proton cyclotron fundamental frequency, possibly associated with the decay of the diamagnetism of the plasma ($\beta \sim 0.016$). Ion cyclotron lines at the lithium ion cyclotron resonances appear when the beam is injected. The predominant proton cyclotron radiation seen is at the second, third, and fourth harmonics. No evidence is found of low-frequency rotations of the plasma as a whole. (auth)

32896 (ORNL-3652(p.39-45)) ELECTRON-CYCLOTRON HEATING. (Oak Ridge National Lab., Tenn.).

Investigations have been made of the electron-cyclotron plasmas in both the EPA Facility and the Physics Test Facility (PTF). The electron-cyclotron plasma (ECP) volume and shape in the EPA Facility have been studied with an x-ray pinhole camera. The plasma density in the PTF has been studied with a microwave interferometer in conjunction with other diagnostic aids. However, both machines have been inoperative for long periods of time because of necessary modifications. The EPA Facility has been modified for an experiment involving the injection of a 15- to 22-kev neutral hydrogen beam of several milliamperes into the ECP. The PTF has been modified for experiments involving r-f ion-cyclotron heating in connection with microwave electron-cyclotron heating. (auth)

32897 (ORNL-3652(p.46-70)) PLASMA PHYSICS. (Oak Ridge National Lab., Tenn.).

"Burnout," or complete ionization of a plasma, has apparently been accomplished by means of intense heating via electron-beam–plasma interaction. The burnout phenomenon appears to explain the mode I–mode II transition phenomena. Preliminary studies of a burned-out plasma have been made, and ion heating effects have been observed. Studies of the hot-electron plasma have been made at lower background pressures using a pressure-reducing technique. At reduced pressures, the plasma can still be stable. A simple calculation shows that density measurements of the hot-electron plasma by means of the x-ray bremsstrahlung flux were not made grossly inaccurate by high-Z contaminants. An energetic high-intensity electron beam has been observed to heat the electrons in a beam-generated plasma to temperatures about equal to the beam velocity, 15 to 30 kv, while operating in a uniform magnetic field. Plasma electron density is measured to be in the range of 10^{10} to 10^{11} electrons/cm^3. Evidence of some type of ion-accelerating mechanism has been obtained from the severe erosion of the walls of the interaction region. Extensive studies of moving striations in the rare gases in gas discharge tubes have been made using an image-converter stroboscope. These studies strongly suggest that the striation velocity corresponds to the ionic sound wave velocity as modified by ion-neutral collisions. (auth)

32898 (ORNL-3652(p.71-7)) VACUUM ARC RESEARCH. (Oak Ridge National Lab., Tenn.).

Deuterium-arc flute velocity and cross-field plasma transport measurements have been carried out. Flute velocities near the arc core are as high as several times 10^6 cm/sec. The weak radial density gradient dependence on the magnetic field strength has been verified out to the maximum available field strength. Some effects of a very weak quadrupole Ioffe field have been measured, but a relatively weak Ioffe field distorts the mirror field lines sufficiently to extinguish the arc. The Long Solenoid has been doubled in length. Development of a hydrogen arc for DCX-2 has been started. The magnetically confined carbon and gas-fed carbon arc plasmas are characterized by an unusual dynamic equilibrium–the ions appear to be as much as 100 times "hotter" than the electrons. This remarkable situation suggests the presence of a vigorous energy pumping mechanism whereby electrons pump energy in quantized amounts into ions which then, via exothermic ionic collisions, convert the internal potential energy into increased kinetic energy of the ions. These latter reactions correspond to fusion on an atomic scale, with the result that the ions escalate to an energy well above that of the electrons. (auth)

32899 (ORNL-3652(p.78-83)) CROSS-SECTION MEASUREMENTS. C. F. Barnett, J. A. Ray, and J. C. Thompson (Oak Ridge National Lab., Tenn.).

Pressures less than 10^{-10} torr have been obtained with the cross-beam cross-section apparatus. Preliminary measurements of the H^0 formation from H_2^+ dissociation in an arc discharge have indicated 2% of the total incident H_2^+ is converted to neutrals. Total attenuation cross sections for H_2^+ and H_3^+ in hydrogen gas have been completed. The cross section decreases monotonically for both H_2^+ and H_3^+ in the energy range of 40 to 220 kev. Angular distribution measurements of H_2^+ and H^+ resulting from gaseous dissociation of H_3^+ indicate that these fragments arise from the same H_3^+ repulsive state independently of the target mass. Evaluation of a proportional counter to be used for detection of low-energy neutral particles has been completed. The resolution changed from 76% for 2.5-kev H^+ to 10% at 30 kev. The counter was nonlinear for proton energies less than 17 kev. (auth)

32900 (ORNL-3652(p.96-104)) PLASMA THEORY AND COMPUTATION. (Oak Ridge National Lab., Tenn.).

Thermodynamic upper bounds on anomalous diffusion across magnetic fields are found to agree with experiments. In particular, in quiet afterglows an observed rapid decrease of anomalous diffusion at large plasma radii is explained. The bound predicts adequate thermonuclear confinement in a torus stabilized against interchange and other "macroinstabilities" (minor radius <100 cm). The thresholds in density and magnetic field for electrostatic instabilities in plasmas created by high-energy injection are displayed graphically. Effects of ion and electron temperature and ion temperature anisotropy are surveyed. Also, the ion distribution is allowed to rotate at the ion cyclotron frequency, approximating the diamagnetic currents in plasmas one or two ion orbits across (DCX-1, DCX-2,

OGRA). Finally, stability boundaries are determined from a new dispersion relation treating plasmas of finite radius, including both the above extreme case and also plasmas several orbits across (ALICE, PHOENIX). Qualitative understanding of calutron instabilities is discussed, as well as plasma impedance calculations motivated by an attempt to understand the observed stabilization thereof by external circuits. Ambipolar scattering losses in mirrors are calculated to provide an estimate of losses at high density in minimum-B experiments, such as that of Ioffe. Typical ambipolar enhancement of losses is a factor of about 3 to 4. Investigation of a possible anomaly in microwave interferometric density measurements in hot-electron plasmas has led to the conclusion that mirror curvature, like high-temperature relativistic effects, makes a negligible correction to the appropriate refractive index. Progress on calculations of electron-steam–plasma interaction is reported. (auth)

32901 (RISÖ-75) SOME EXPERIMENTS ON A THETA PINCH. T. H. Jensen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Jan. 1964. 21p.

Experiments related to two subjects were performed: initial ionization and the existence of angular momentum in a theta-pinch plasma. The theta pinch used was of rather low power with a maximum magnetic field of 25 kGauss, a rise-time of 10^{-6} sec, and crowbarring after $^3/_4$ of a period. The diameter of the discharge tube was 4 cm and the length of the theta-pinch coil 25 cm. In this theta pinch no breakdown occurred unless some preionization was effected; even a preionization so weak that the Debye length in the preionized gas was bigger than the diameter of the discharge tube would cause breakdown. An attempt was made to measure the angular momentum of the plasma by means of a torsion pendulum suspended along the axis of the discharge tube. Most theories of the origin of the angular momentum predict a momentum proportional to the trapped flux. The trapped flux could be varied by varying the preionization, and, supposing that the pendulum would measure the angular momentum, the predicted correlation could be checked. The experiments did not show the expected correlation. (auth)

32902 (UCRL-7815) A STUDY OF THE HOMOPOLAR GENERATOR AS AN ENERGY-STORAGE DEVICE. Hugh W. Van Ness and G. Gordon North (California. Univ., Livermore. Lawrence Radiation Lab.). June 1, 1964. Contract W-7405-eng-48. 38p. (CONF-604-1)

From 3rd Symposium on Engineering Problems in Thermonuclear Research, Garching near Munchen, Ger., June 1964.

A test program for establishing operating limits for essentially standard, commercially available generators of the Faraday disk type is discussed. The generator uses NaK brushes and is to be used to power a stabilizing-bar field system on the Alice magnetic mirror machine. The device is used for pulsed-output storage and is capable of 1800 kw d-c at 30 volts and 60,000 amp. (R.E.U.)

32903 (NP-14083) VZAIMODEISTVIE POTOKOV ZARYAZHENNYKH CHSTITS S MAGNITOAKTIVNOI PLAZMOI. (The Interaction of Flows of Charged Particles with a Magneto-Active Plasma (thesis)). A. B. Kitsenko (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1963. 87p.

Interactions of charged-particle currents with slow waves in an electron plasma with an external magnetic field are surveyed. The dispersion equation and expressions for components of the dielectric-permeability tensor are derived. Excitations of longitudinal oscillations by a rarefied cluster and of waves by quasilongitudinal diffusion are investigated. The increments of wave growth are obtained for excitation by cold and hot clusters. The mechanism of oscillation by cyclotron excitation with anomalous Doppler effect is discussed. The interaction of charged-particle currents with low-frequency electron-ion oscillations of the plasma is considered. Excitation of ion-cyclotron, Alfven, and magnetosonic waves is investigated in detail. Interactions of excited oscillators with plasma currents are studied; the plasma dielectric-permeability tensor, the excitation of longitudinal electron oscillations, effects of quasilongitudinal diffusion, and excitation of ion-cyclotron and magnetohydrodynamic waves are discussed. The energy losses of current charges and of charged-particle clusters upon passage through an electron plasma with velocity significantly higher than the plasma thermal velocity are determined. The frequency of the radiated waves is found. (M.J.T.)

32904 FORMATION AND PROPAGATION OF A PRESSURE WAVE IN A WEAKLY IONIZED GAS. J. Berlande, P. D. Goldan, and L. Goldstein (Univ. of Illinois, Urbana). Appl. Phys. Letters, 5: 51-2(Aug. 1, 1964).

The propagation of pressure waves formed in helium and neon plasmas was investigated by observing variations of the electrical and optical characteristics. It was concluded that a pressure wave propagates in the neutral gas along the x-direction; the ion and electron gases are forced to follow, due to collisional and space-charge effects; and the observed modulation of the plasma light and transmitted microwave signal is the result of such local compression and rarefaction of the electron gas. The temperature of the neutral particles, computed from measurements of the wave velocity and compression ratio, was found to be between 90 and 75°K. (L.B.S.)

32905 SPATIAL DENSITY MEASUREMENTS IN FAST THETA-PINCH PLASMA BY LASER EXCITATION OF COUPLED INFRARED RESONATORS. Robert F. Gribble, John P. Craig, and Arwin A. Dougal (Univ. of Texas, Austin). Appl. Phys. Letters, 5: 60-2(Aug. 1, 1964).

An electron density, measured by He–Ne laser excitation of coupled infrared resonators at 3.39 μ, of $5.5 \times 10^{15}/cm^3$ was observed following super high power plasma preheating, for 0.1 Torr initial deuterium pressure. Resonator intensity modulation frequencies higher than 6 Mc/sec, corresponding to an electron density variation of $10^{16}/cm^3/\mu sec$, were observed during fast magnetic compression to a peak of 11 kG in 3.5 μsec. The 6 Mc/sec upper frequency limit for this coupled resonator system is due to the time response of the IR detectors, rather than to the laser Q. These results confirm the expectations that the coherence, monochromaticity, and low beam divergence of IR lasers could be effectively used in a coupled resonator plasma diagnostic technique. (L.B.S.)

32906 A PROBLEM OF SCATTERING OF THE MAGNETIC FIELD IN A CONDUCTING FLUID. Mario Primicerio (Università, Florence). Atti Seminar. Mat. Fis. Univ. Modena, 12: 140-62(1962-63). (In Italian)

Within the framework of the scattering phenomenon of the lines of force of a magnetic field inside a fluid of finite conductivity and within the limits of the unidimensional case, the propagation of a perturbation arising instantaneously inside a given point (with two diverse initial configurations) is studied. The case in which the perturbation is mobile is then examined. For all problems the expression of the solution is given in explicit form, ac-

companied by some calculations and a brief discussion. (tr-auth)

32907 THE STABILITY OF A PLASMA AT FINITE PRESSURE. Jean Andreoletti (CEN, Saclay, France). Compt. Rend., 258: 5183-6(May 25, 1964). (In French)

A condition necessary for stability for any state whatever without magnetic surfaces and a condition sufficient for a state with isotropic pressure and without parallel current were obtained. These two conditions tend toward the necessary and sufficient condition for very small β and very large β, respectively. An evaluation of the critical β in a magnetic well was deduced, showing the role of the transverse depth. (tr-auth)

32908 SLOW WAVES SUSCEPTIBLE OF BEING PROPAGATED IN A WAVE GUIDE COMPLETELY OR PARTIALLY FILLED WITH PLASMA IN THE PRESENCE OF A UNIFORM LONGITUDINAL MAGNETIC FIELD. Michel Camus (Centre National d'Études des Télécommunications, Issy-les-Moulineaux, France). Compt. Rend., 258: 5821-4(June 15, 1964). (In French)

There are slow waves in the vicinity of the plasma frequency and the electron cyclotron frequency in a circular wave guide completely or partially filled with a column of homogeneous plasma in the presence of a uniform longitudinal magnetic field. The properties of these waves depend principally on the dimensions of the plasma column and very little on the position of the metallic wall of the guide. (tr-auth)

32909 ON THE RADIATION THEORY OF A HYDROGEN LIKE PLASMA IN A STRONG ELECTRIC FIELD. V. A. Zhirnov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 89-90(1962). (In Russian)

Equations were developed to investigate the intensity of bremsstrahlung and recombination radiation emitted from a hydrogen-like plasma in a strong electric field. (C.E.S.)

32910 ON THE THEORY OF INTEGRAL ABSORPTION IN HETEROGENEOUS PLASMA LAYER. N. G. Preobrazhenskii. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 90-4(1962). (In Russian)

Previous work on the theory of integral absorption based on the phenomenological theory of the reabsorption of spectral lines is investigated taking into account spatial inhomogeneities of the luminescent plasma layers. A bibliography of 23 references is included. (C.E.S.)

32911 SPECTROSCOPIC INVESTIGATIONS OF ALPHA INSTALLATIONS. A. N. Zaidel, V. A. Belyaeva, A. B. Berezin, et al. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 96-102(1962). (In Russian)

The thermonuclear reactor Alpha and its spectroscopic equipment are briefly discussed. The spectra of hydrogen plasma with impurities of oxygen, nitrogen, and carbon were investigated to determine plasma temperature. Spectral lines of the chamber materials were also evident. The spectra of atoms in various stages of ionization are illustrated, and ion temperatures are plotted as a function of the valence state. (C.E.S.)

32912 INTERFEROMETRIC MEASUREMENTS OF GAS DENSITY IN A GAS DISCHARGE PLASMA. A. M. Shukhtin and Yu. G. Kozlov. Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-go [Trinadtsatogo] Soveshch. Leningrad, 1960, 1: 149-51(1962). (In Russian)

Interferometric measurements of the density in an argon discharge plasma are presented. The discharge had a duration of about 200 μsec and a current amplitude of 800 to 1000 amp. (C.E.S.)

32913 ON HIGH-FREQUENCY CONDUCTIVITY OF MAGNETOACTIVE PLASMA. Yu. B. Ivanov and A. A. Rukhadze (Levedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 232-41(1964). (In Russian)

An expression is obtained for high-frequency conductivity of the fully ionized magnetoactive plasma, the wavelengths being less than electron ω_H gyroradius. The absorption of such short-wave oscillations is investigated at the frequencies multiple to ω_H. (auth)

32914 ELECTROMAGNETIC WAVES IN A HALF-SPACE PLASMA. Yu. A. Romanov (Gorky Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 242-50 (1964). (In Russian)

By the kinetic equation method plasma energy spectrum of half space plasma was considered assuming a mirror reflection of electrons from the boundary. The problem is considered of the excitation of the surface plasma waves by slow electrons. (auth)

32915 ON THE KINETIC INSTABILITY OF UNIFORM MAGNETOACTIVE PLASMA. A. A. Andronov, V. V. Zheleznyakov, and M. I. Petelin (Gorky Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 251-61(1964). (In Russian)

Kinetic instability of uniform magnetoactive plasma is considered the momentum distribution function of which is $f = G \exp[-(p_{||} - p_{||}^0)^2 a_{||}^{-2} - (p_\perp - p_\perp^0)^2 a_\perp^{-2}]$ where $(p_{||})$ and $(p_\perp)$ are the longitudinal and transverse components of momentum correspondingly. The electromagnetic perturbations are plane waves propagating at arbitrary angles to the magnetic field H_0. Instability criteria obtained admit a simple quantum interpretation. The expression for the absorption coefficient for electromagnetic waves near the first gyrofrequency harmonic in the equilibrium plasma is given. (auth)

32916 ON THE NONLINEAR OSCILLATIONS OF TWO-COMPONENT PLASMA. N. P. Giorgadze and N. L. Tsintsadze (Inst. of Physics, Academy of Sciences, Georgian SSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 262-72(1964). (In Russian)

The propagation of waves in plasma along the constant magnetic field is considered. In approximation of small nonlinearities the amplitudes of overtones due to interaction of the linear waves are found. (auth)

32917 KINETIC THEORY OF ELECTROMAGNETIC WAVES SCATTERING IN PLASMA. O. P. Pogutse. Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 280-90(1964). (In Russian)

The electromagnetic waves scattering in plasma was considered on the basis of a kinetic equation for microscopic distribution function. (auth)

32918 WAVE TRANSFORMATIONS IN NONEQUILIBRIUM PLASMA. Ts. D. Loladze and N. L. Tsintsadze. Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 374-5(1964). (In Russian)

The transformation of longitudinal waves to transverse waves at a plasma-vacuum interface is investigated. (C.E.S.)

32919 MEASUREMENTS OF SHOCK TUBE IONIZATION PHENOMENA BY A NEW MICROWAVE METHOD. Richard A. Brandewie (North American Aviation, Anaheim, Calif.) and Everard M. Williams. J. Appl. Phys., 35: 2299-2308(Aug. 1964).

Measured values of electron density and collision frequency in shock-heated argon are presented and compared with theoretical equilibrium values. Both parameters are measured as a function of time during a single shock tube experiment. The measured density at 1 and 3 torr forepressure equals or exceeds the predicted 10^{16} – 10^{17} electrons per cc at high Mach number (15-18); for lower Mach number, measured values fall far below the calculated curve, showing that loss mechanisms dominate thermal electron production over a significant interval of shock wave flow. The measured collision frequency compares well with the predicted value at 1 torr but is lower by about an order of magnitude at 3 torr. The experimental configuration comprises a theta pinch driven shock tube designed to drive a shock front into a coaxial waveguide. Two types of interference patterns are observed by transverse sampling of the longitudinal waves: the first, an anomalous pattern, is interpreted as a resonance caused by electrons ahead of the shock; the second, a well-defined interference between incident and reflected waves, yields measurements of the plasma reflection coefficient magnitude and phase. (auth)

32920 PROPOSED LOSSLESS DISSOCIATING PLASMA FOR USE WITH A DCX-TYPE DEVICE. A. W. Ehler (Hughes Research Labs., Malibu, Calif.). J. Appl. Phys., 35: 2309-11(Aug. 1964).

A novel method is proposed for dissociating high-energy molecular ions, such as H_2^+, which are injected into a magnetic mirror container. The dissociating medium is a highly ionized plasma consisting of protons and high-energy electrons ejected in the decay of dense thermal neutrons which exist within a nuclear research reactor. The plasma is accumulated within a weak magnetic mirror container inside the reactor and then transferred magnetically to the site where the H_2^+ injection is to take place. Finally the dissociating plasma is compressed magnetically to a density of $10^{11}/cm^3$ and injection is begun. The plasma provides an efficient means for dissociating the injected H_2^+ ions, but contributes negligibly to charge exchange losses of trapped high-energy protons. (auth)

32921 PLASMA EXPERIMENTS WITH A 570-kJ THETA-PINCH. F. C. Jahoda, E. M. Little, W. E. Quinn, F. L. Ribe, and G. A. Sawyer (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 35: 2351-63(Aug. 1964). (LADC-6260)

Initial measurements on the plasma produced in the Scylla IV theta-pinch of its electron density, soft x-ray emission, neutron emission, plasma shape and motion were carried out as a function of the initial deuterium pressure and bias magnetic field. Interferograms establish electron densities in the range 4 to 7×10^{16} cm^{-3} for the plasma at peak compression and give azimuthally symmetric plasma shapes, which show the absence of the rotating flute instability as well as the absence of large trapped magnetic fields at peak compression. Streak photographs also indicate gross plasma stability. Shadowgraphs in conjunction with deflection mapping of a grid pattern show sharp plasma boundaries. Soft x-ray absorption measurements yield plasma electron temperatures in the range 400 to 1200 ev, which are dependent on the magnitude of the reversed bias field and have a gross correlation with the neutron emission. Neutron emissions in the range 10^7 to 2×10^9 per discharge are observed and depend upon the magnitude of the reversed bias field. Neutron collimation experiments yield a plasma length of approximately 70 cm in the 1-m mirrorless compression coil. The observed electron temperature, neutron emission, and electron density as functions of the bias magnetic field and filling pressure are consistent with the product of the plasma particle energy and the plasma density being a constant, as required for a $\beta = 1$ plasma. (auth)

32922 MICROWAVE REFLECTION PROBE. Susumu Takeda and Takashige Tsukishima (Nagoya Univ., Japan). J. Appl. Phys., 35: 2548-9(Aug. 1964).

A previously proposed microwave reflection method is extended to measure high electron densities of plasmas in free space. A section of waveguide terminated by a thin mica plate is used as a probe. The electron density is obtained from the phase angle of the reflection coefficient for a plasma whose density is above critical. The method is illustrated for an argon afterglow plasma. (C.E.S.)

32923 DAMPING OF PLASMA WAVES IN THE WEAK MAGNETIC FIELD. Utaro Furukane (Hiroshima Univ.). Kaku Yugo Kenkyu, 12: No. 2, 81-97(Feb. 1964). (In Japanese)

The coefficient of collision damping of the plasma wave, in a constant weak magnetic field, is calculated by means of the Fokker-Planck collision term. It is found that the damping of the electromagnetic wave increases with an increase in magnetic field, but the damping of plasma oscillation decreases in the case of $\vec{B}_0 \perp \vec{K}$. The Landau damping coefficient is also calculated. (auth)

32924 INJECTION OF CHARGED PARTICLES INTO A MAGNETIC BOTTLE, AND ACCELERATION OF CHARGED PARTICLES IN A MAGNETIC BOTTLE. Teruo Tamano (Tokyo Univ.). Kaku Yugo Kenkyu, 12: No. 2, 116-38(Feb. 1964). (In Japanese)

When a magnetic bottle is deformed repeatedly by an adiabatic process, some charged particles lose their kinetic energy. By the use of this process charged particles are injected into a magnetic bottle. Without consideration of other processes, for example, a collision process, charged particles are injected one after another by this process as long as adiabatic approximations are valid. Moreover, charged particles in a magnetic bottle can be accelerated by the reverse process. (auth)

32925 MICROWAVE REFLECTION PROBE. Takashige Tsukishima and Susumu Takeda (Nagoya Univ., Japan). Kaku Yugo Kenkyu, 12: No. 2, 139-53(Feb. 1964). (In Japanese)

A microwave probe is proposed, which consists of a waveguide or coaxial cable terminated by a thin insulating material. The probe can be applied to unbounded plasmas whose electron plasma frequencies, ω_p, are higher than the applied microwave frequency ω. The principle is based on the fact that the phase angle of the reflection coefficient is a direct measure of the electron density of the plasmas. The electron densities measured by a waveguide probe are compared for a range of $\omega_p^2/\omega^2 < 10$ with those obtained also by a reflection method developed already by the authors for plasmas bounded in the waveguide. The electron density measured by the probe showed a slightly larger value than the real value for the measured range, and it is shown that this difference is reasonable if the effect of the fringing field outside the probe is taken into considerations. The difference is expected to disappear for the range of $\omega_p^2/\omega^2 \gg 1$. Although an electron density range from 5×10^{11} to 6×10^{12} cm^{-3} is measured by an X-band (9 Gc) waveguide probe in the present experiment, a K-band (35 Gc) probe scaled down to a smaller dimension is recommended for higher densities. Finally it is pointed out that the proposed probe is suitable for high-density measurement, has good time and space resolu-

tions insensitive to the magnetic field, needs no auxiliary information of the electron or ion temperatures, and is very simple in treatment and calculation. (auth)

32926 MEASUREMENT OF THE $v \times \beta$ EMF BEHIND MAGNETOHYDRODYNAMIC COLLISION WAVES IN TRANSVERSE MAGNETIC FIELDS. L. Rothhardt (Institut fur Magnetohydrodynamik, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 6: 166-71(1964). (In German)

Preliminary experiments on the measurement of the EMF behind MHD collision waves are reported. Oscillograms of the transient behavior of the voltage show an exponential decay of the EMF. The effect of load resistances on the electrode pairs was determined. It was shown that the time decay was not caused by a deceleration of the gas current. The internal resistance of the probe gaps was estimated as a function of time. The time pattern of the EMF over the first 200 μsec is attributed to a matter movement. (J.S.R.)

32927 FLOW LIMITED TOTAL CONDUCTIVITY ANISOTROPY IN ISOTROPIC MEDIA WITH STATISTICAL CONDUCTIVITY FLUCTUATIONS. F. Krause and M. Steenbeck (Institut fur Magnetohydrodynamik, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 6: 174-83 (1964). (In German)

A shear-streaming in an electrically conducting isotropic fluid medium is considered. The conductivity undergoes fluctuations, which appear because of random processes and disappear according to a diffusion equation or according to an exponential law with a constant decay time. It is shown that the average field strength and the average current density are, in general, not parallel. For an electric field orthogonal to the direction of the velocity, the direction of the current density undergoes a rotation in the sense of shear-streaming. The effect may be of importance in dynamo theories of rotating stars, because it gives a mechanism for producing poloidal magnetic fields from toroidal ones. The analytical expressions for the components of the conductivity tensor are given. (auth)

32928 PRODUCTION OF HIGHLY EXCITED NEUTRAL ATOMS FOR INJECTION INTO PLASMA DEVICES. S. T. Butler, R. M. May, and I. D. S. Johnston (Univ. of Sydney). Phys. Letters, 10: 281-2(June 15, 1964).

Calculations of the transition probabilities for electron exchange in the charge exchange reaction $H^+ + H(1s) \rightarrow H$ (excited) + H, with respect to the S system and using first-order time-dependent perturbation theory, were extended. A full Lorentz transformation was employed which eliminated the unphysical logarithm divergence resonance obtained in the previous calculation of the total exchange cross section. An analysis of the distribution of orbital angular momentum final states shows that, at resonance, p states predominate among the final highly excited states with s state formation contributing 29% of the resonance. (L.B.S.)

32929 ELECTRON TEMPERATURE MEASUREMENTS USING THE STARK EFFECT. D. D. Burgess (Imperial Coll. of Science and Tech., London). Phys. Letters, 10: 286-7(June 15, 1964).

A method of using the Stark effect in emission lines from a plasma to obtain directly the electron temperature is described. Results of the application of this method are presented. (L.B.S.)

32930 INJECTION OF CHARGED PARTICLES INTO A STATIC MAGNETIC CYLINDER HAVING SYMMETRY OF REVOLUTION. P. Hubert (EURATOM-CEN, Fontenay-aux-Roses, France). Phys. Letters, 10: 292-3(June 15, 1964). (In French)

An experiment in trapping 5-kev electrons was performed in CAPEL-A, a magnetic mirror cylinder with static field, using a single coil to reduce the field for a short distance in the central region, without destroying symmetry. The duration of provisional capture was measured to study the electrons escaping from the cylinder when the injected current is abruptly cut. Optimal conditions were obtained when only half the cluster penetrated the cylinder. The best experimental value corresponds to an average capture time equal to 6 μsec for the fraction of the cluster which penetrates. An average of 110 transits for the penetrating particles is deduced. This result is compared with the upper limit of 10^5 calculated from the Liouville theorem. (M.J.T.)

32931 OPTICAL-ENERGY ABSORPTION AND HIGH-DENSITY PLASMA PRODUCTION. R. G. Meyerand, Jr., and A. F. Haught (United Aircraft Corp., East Hartford, Conn.). Phys. Rev. Letters, 13: 7-9(July 6, 1964).

It was observed experimentally that an incident optical-frequency laser beam was severely attenuated by the plasma breakdown produced by the beam in a gas. The energy removed from the beam is much greater than that required to ionize the plasma atoms. Most of the energy is neither scattered at the laser frequency nor reradiated by excited atoms but is truly absorbed, producing an increase in the electron density and temperature of the plasma. There is a discrepancy between the prediction of conventional microwave theory and the observed ionization rates for the early portion of the breakdown. Apparently complete ionization of atmospheric-pressure gases is achieved, as over 90% attenuation occurs; thus clean plasmas with electron densities of the order of 10^{19} cm^{-3} can be produced. (M.J.T.)

32932 RESPONSE OF AN UNSTABLE PLASMA TO AN ELECTRIC FIELD. Edward C. Field (Univ. of California, Los Angeles) and Burton D. Fried. Phys. Rev. Letters, 13: 81-3(July 20, 1964).

The results of a calculation of the runaway phenomenon, production of a current which is proportional to time by a critical field of the order of $E_R = amv/e$, are reported. The couple equations for the average distribution function and for the fluctuations about it are solved in a self-consistent fashion for the case of a strong field. Results were found to be in qualitative agreement with those obtained in the moment approximation. (L.B.S.)

32933 OPTICAL MIXING AS A PLASMA DENSITY PROBE. Norman M. Kroll, Amiram Ron, and Norman Rostoker (Univ. of California, San Diego, La Jolla, Calif.). Phys. Rev. Letters, 13: 83-6(July 20, 1964).

Nonlinear coupling between longitudinal and transverse waves is described by the Vlasov equation, from which an estimate of the scattering of two light waves by stimulated plasma oscillations is made. It is shown that the measurement of the scattered flux is possible with modern laser techniques. (L.B.S.)

32934 STABILITY OF MAGNETIC WELLS AT FINITE PLASMA PRESSURE. R. J. Hastie and J. B. Taylor (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Phys. Rev. Letters, 13: 123-4(July 27, 1964).

It is shown that exact necessary and sufficient stability criteria can be obtained for magnetic fields which possess a nonzero minimum in field strength (magnetic wells) at finite plasma pressure without approximation or restric-

tion as to depth of well or degree of anisotropy. It is also shown that an equation for the maximum pressure for stability gives the limiting pressure in all cases. (C.E.S.)

32935 ON THE THEORY OF PLASMA CYLINDER ROTATION IN A LONGITUDINAL MAGNETIC FIELD. E. I. Urazakov. Radiotekhn. i Elektron., 9: 735-40(Apr. 1964). (In Russian)

An equation for gas motion in a three-component positive cylinder in a longitudinal magnetic field was developed that considers viscosity, inertia, and external forces. The forces acting on the gas column were calculated. The force exerted on a surface in the (zr) plane was estimated. (tr-auth)

32936 ON THE PROBLEMS OF CONVECTIVE AND ABSOLUTE INSTABILITIES. A. M. Fedorchenko (Kiev State Univ.). Radiotekhn. i Elektron., 9: 754-6(Apr. 1964). (In Russian)

A criterion for classifying convective and absolute instabilities of electron beam interactions with electromagnetic waves was developed. (R.V.J.)

32937 ELECTRON BEAM INJECTION INTO PLASMA IN A STRONG MAGNETIC FIELD. I. E. Sakharov and I. F. Liventseva. Radiotekhn. i Elektron., 9: 838-43(May 1964). (In Russian)

Descriptions are given of an electron beam source protected from plasma in the acceleration area and from cathode ion bombardment by heterogeneous external magnetic field. The source is capable of steady performance at pressures to 5×10^{-2} mm Hg. It was found that the heterogeneity formed by meshed magnetic fields reduced the cathode ion current by an order of 3. Studies were made of the characteristics of the injected beam. Electron straggling related to the longitudinal motion did not exceed 20% of the total beam energy. (R.V.J.)

32938 TECHNIQUE FOR MEASURING SELF-ABSORPTION OF SPECTRAL LINES IN PLASMAS. P. J. Dickerman and R. W. Deuel (Univ. of Chicago). Rev. Sci. Instr., 35: 978-80(Aug. 1964).

The instrumentation requirements for determining the self-absorption of spectral lines in a radiating gaseous system were studied using a two-path method with an Ar arc plasma. By observing lines with known transition probabilities, it is possible to check the system using a direct comparison of theoretical and experimental absorption coefficients. Results for 13 Ar lines in the near-infrared suggest an experimental procedure (described) that can be used, in general, provided the source possesses cylindrical symmetry. (auth)

32939 PLASMA CAMERA. F. H. Coensgen, W. F. Cummins, W. E. Nexsen, Jr., and A. E. Sherman (Univ. of California, Livermore). Rev. Sci. Instr., 35: 1072-4(Aug. 1964). (UCRL-7758)

A camera for observations on the spatial distribution of magnetically confined, low-density plasmas of small volume and short lifetime is described. The intensity at any point of the time-resolved image is a function of the instantaneous plasma flux at that point and is insensitive to light or other radiation from the plasma. (D.C.W.)

32940 THE CURRENT OF AN ELECTRON AVALANCHE WITH DIFFUSION. Joerg Brambring (Universität, Hamburg). Z. Physik, 179: 532-8(1964). (In German)

The electron current of an avalanche in a homogeneous electric field was calculated taking into account the influence of the diffusion of the electrons and the boundary effect of the anode. The ionization rate was assumed to be proportional to the current density. The results were significant for measurements of electron diffusion and electron drift velocities. (auth)

32941 DRIFT VELOCITIES OF ELECTRONS IN ARGON. Joerg Brambring (Universität, Hamburg). Z. Physik, 179: 539-43(1964). (In German)

Drift velocities of electrons in pure argon were derived from measurements of transit times in a homogeneous electric field. The electron avalanches were initiated by the light pulse of a spark, and the current of electrons was observed. The influence of diffusion on drift velocity measurements was taken into account. (auth)

32942 BEHAVIOR OF THE LINES OF FORCE OF A PERTURBED CLOSED STELLARATOR MAGNETIC FIELD. A. P. Popryudukhin. Zh. Tekhn. Fix., 34: 658-65(1964).

First-order (linear) perturbation calculations of the change in the rotational transform of a stellarator field induced by a small perturbing field are presented. The perturbation technique was applied to the equation H-grad u = 0 (H is the magnetic field), the integrals of which are constant along a line of force. The first-order change in u was expressed as an integral around the stellarator along an unperturbed line of force. The change was calculated for only that one integral of the equation that represents the topologically toroidal magnetic surfaces, because the second unperturbed integral was now known. Thus, only one component of the change in the rotational transform was obtained. The contribution of the perturbing field was calculated in cylindrical coordinates as though the stellarator tube were straight, and the effect of curvature due to closure of the stellarator tube was obtained separately by a second perturbation calculation. The perturbation of u was summed over successive image points of an unperturbed line of force (the points at which the line of force intersects a plane normal to the axis of the stellarator tube on successive traversals around the stellarator), and the sum was replaced by an integral under the assumptions that the line of force densely fills the magnetic surface and that successive image points are close together. The result presumably gave the perturbation of the magnetic surface. In case of degeneracy, when the unperturbed line of force closed on itself after several traverses of the stellarator, the perturbation calculated in this way was infinite, and it was concluded that linear theory is not applicable. The perturbation of the magnetic surfaces due to a small perturbing dipole was calculated as an example. (A.I.D. Press)

32943 DYNAMIC COMPRESSION OF PLASMAS BY HIGH MAGNETIC FIELDS. Alan C. Kolb (Naval Research Lab., Washington, D. C.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-374, 11p. $1.00. (CONF-600-18)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

Plasma dynamics in a theta pinch discharge are discussed, and the MHD equations for the plasma dynamics and ion and electron heating rates are derived. (C.E.S.)

32944 LOW-LOSS PLASMA WAVEGUIDE. P. Govindan. 4p. (CONF-471-26)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The figures of merit of the plasma column of hot-cathode electric discharges concentric with a microwave cavity are measured and calculated theoretically. The application of the results to the design of low-loss plasma waveguides is discussed. (T.F.H.)

32945 CHARACTERISTICS OF STRONG SHOCKS IN ELECTRICALLY DRIVEN SHOCK TUBES. M. Eisner, Paul Bottoms, and Robert Henson (Texas Agricultural and Mechanical Coll., College Station). 15p. (CONF-531-6)

From American Physical Society 1964 Southwestern Meeting, Tucson, Ariz., Feb. 1964.

Shock front velocities are measured in air, He, and N_2 at ambient pressures of 0.050 to 0.400 torr. The data are compared with theoretical predictions of velocity based on the Hugoniot equation. The theoretical analysis assumes the shock to be strong, and to be propagating in a perfect gas. The shock waves studied experimentally are found to approximate the blast-wave model in the 0 to 15 cm region of propagation; energy losses beyond 15 cm, however, cause divergence between the experimental and theoretical values. (T.F.H.)

32946 BASIC PERFORMANCE LIMITS OF COAXIAL ARC GAS HEATERS. G. L. Gann, R. L. Harder, R. D. Buhler, and R. A. Moore (Electro-Optical Systems, Inc., Pasadena, Calif.). 62p. (CONF-363-21)

From International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963.

Extensive measurements in a cascade-type arc were carried out with four gases (hydrogen, helium, ammonia, and argon) covering both the inlet region and the fully developed region of the coaxial flow discharge. The inlet (gas heater) region results for three gases were compared with the Stine-Watson first order theory. For the size-pressure regime in which radiation can be neglected, the Stine-Watson relations with empirically adjusted constants gave a good semi-empirical description of all the inlet cases investigated. To estimate the ultimate technical limits of arc-gas-heater performance the approximate theories for the fully developed arc column (Parabola and Bessel Models) were extended to include radiation and, for the high current regime, the self-magnetic pressure gradient. Hot gas containment limits were calculated for air, for a range of allowable wall heat loads (0.1 to 10 kw/cm^2). This resulted in a predicted "absolute" technical limit of continuous hot gas containment independent of size, within the pressure-size range of the optically thin gas approximation. The theoretical containment limit curves appropriate for a highly cooled thin metal wall fell substantially above the previously published empirical state of the art performance envelope for continuous arc tunnel heaters. Heat loads from mechanisms other than the simple hot gas containment (e.g., electrode heat loads, local secondary arcs, etc.) limited the enthalpy-pressure values achieved. Gas heater performance substantially above the 1961 state of the art curve appeared technically possible, with optimum designs. (auth)

32947 METHOD FOR THE GENERATION OF A HIGH-TEMPERATURE PLASMA. Persa Raymond Bell, Robert James Mackin, Jr., and Albert Simon (to U. S. Atomic Energy Commission). German Patent 1,165,776. Mar. 19, 1964. Priority date Aug. 7, 1958, United States.

The plasma generation method is characterized by a succession of steps: generation of a longitudinal magnetic field featuring two permanent mirror portions; generation of an additional mirror portion having a mirror ratio of 3.5:1 (temporary mirror portion) between the two permanent mirror portions for establishment of magnetically enclosed sub-volume; ignition of an arc discharge between the cathode and anode; injection of energetic molecular ions (about 600 kev and 1 a) into the arc discharge; increasing the strength of the magnetic fields of all portions at least five times and at the same time turning off the arc discharge and the injection; and injection of cold fuel particles into the hot plasma of the sub-volume and increasing the sub-volume so that at the end of the cycle the whole volume between the two permanent mirror portions is filled with hot plasma. (Gmelin Inst.)

Shielding

Refer also to abstracts 31742 and 31935.

32948 (EUR-534.d(Pt.I)) ABSCHIRMUNGSEXPERIMENTE AM FORSCHUNGSREAKTOR GEESTHACHT, JAHRESBERICHT 1961. (Annual Report About Shielding Experiments at the Reactor Station Geesthacht, During 1961). (Gesellschaft fur Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany). 1964. 215p.

The planning for the shielding experiments at the Reactor Station Geesthacht during 1961 are reviewed. Some of the results obtained are reported. The areas of study discussed are: shielding research on steel tube 5 with collimated beams, preliminary tests of the measurement techniques on steel tube 6, shielding research in vessel IV, shielding studies in the irradiation channel, and development and testing of measurement devices for shielding studies. Theoretical studies were made on the shielding effect of Raschig rings in static packing and some methods for the calculation of fast neutron spectra. The apparatus used for beam shielding studies with collimated beams is described. The design of a recoil proton spectrometer is presented, and the attenuation of the particle intensity in the spectrometer is calculated. (J.S.R.)

32949 (EUR-534.d(Pt.II)) ABSCHIRMUNGSEXPERIMENTE AM FORSCHUNGSREAKTOR GEESTHACHT, JAHRESBERICHT 1962. (Annual Report About Shielding Experiments at the Geesthacht Reactor Station, During 1962). (Gesellschaft fur Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany). 1964. 316p.

The annual report on shielding experiments at the Geesthacht Reactor Station during 1962 is presented. The construction of the experimental apparatus ESTAKOS was described. The ESTAKOS experiment should give a survey of the beam penetrability of shield arrangements of given layer thickness. The method of investigation is described and the measurement results in pure water and some shield arrangement are given. The shielding experiments carried out on large plates are reported. The experimental set-up is described, and some results for pure water and shield arrangements are given. The work on the development of semiconductor detectors for the spectrometry of fast neutrons and threshold detectors is reviewed. A method for the preparation of semiconductor detectors is described and their properties were determined. Some measurements of the spectra of fast neutrons for the reactor and the resolution of neutron energies from 0 to 5.2 Mev are given. Measurement methods were developed for the determination of fast integral neutron fluxes using threshold detectors in the shield. The properties of the ^{32}S, ^{31}P, ^{58}Ni, and ^{27}Al detectors used in the shielding studies are tabulated, and the flux determination from the activities measured is described. Some theoretical studies on the calculation of neutron flux and gamma radiation in shielding arrangements are summarized. Some programs for the calculation of the shielding effect of layer arrangements were formulated. (tr-auth)

32950 (WAPD-TM-448) P-3 MULTIGROUP CALCULATIONS OF NEUTRON ATTENUATION IN METAL–HYDROGENOUS SHIELDS. K. Shure (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1964. Contract AT(11-1)-Gen-14. 28p.

Neutron penetration in water and in iron-water shields was calculated using a P-3 multigroup program. The thermal neutron fluxes from a point fission source in water obtained from calculation and experiment agree to within 18% in the region between 15 and 140 cm, covering more than 9 decades of attenuation. The calculated neutron spectrum compares favorably in shape and magnitude with moments method results out to 120 cm of water. The observed variations of the thermal neutron flux in an iron-water shield are predicted by the P-3 program. Some of the differences between experiment and the predicted thermal flux within a thick iron region are due to the single-energy-group treatment in the calculations. Uncertainties in the high-energy cross sections for iron are of sufficient magnitude to account for differences between calculation and experiment noted in the water region following iron. (auth)

32951 ATTENUATION OF NEUTRONS POSSESSING AN ENERGY EXCEEDING 1.5 Mev IN IRON. V. N. Avaev, Yu. A. Egorov, and G. G. Moiseev. At. Energ. (USSR), 16: 355-6(Apr. 1964). (In Russian)

On the basis of previous investigations of the passage of fast neutrons through Fe it was assumed that as the fast neutron energy approaches the inelastic scattering threshold value, the relaxation length of the fast neutrons should be increased. The problem was investigated in a water-cooled, water-moderated reactor under conditions of semi-infinite geometry, measuring the spatial distribution of neutrons having $E_n > 15$ Mev in Fe. An In indicator based on the $In(n,n')^m$ in reaction, with an effective energy threshold of 1.5 Mev, was used for recording the spectrum. Fe specimens with thicknesses ranging up to 90 cm were used in the study. It was found that the relaxation length of the $E_n > 1.5$ Mev neutrons exceeds the known relaxation length of high-energy neutrons. An increase of the thickness resulted in an increase of the relaxation length; this may be due to the buildup of the neutrons with energies close to the threshold value of the inelastic scattering on Fe nuclei. Tests made with threshold detectors of $P(E_{thresh} = 3$ Mev) and $Al(E_{thresh} = 5$ and 7 Mev) yielded relaxation length values of 6.7, 6.25, and 6.4 cm, respectively; these values are in good agreement with published data. (TTT)

32952 THE USE OF LEAD FOR NUCLEAR SHIELDING IN FRANCE. A. Aupetit. p.137-40 of "Lead 62." London, Lead Development Association, 1962.

The economic aspects of lead shielding and the technical aspects of preparing lead-clad steel are discussed. The applications of lead-clad steel for laboratory doors, marine reactors, and transport containers are also considered. (C.E.S.)

32953 THE MANUFACTURE OF SPECIAL LEAD SHIELDS FOR NUCLEAR SHIELDING. H. Arnold Jenkinson (W. G. Jenkinson Ltd., Sheffield, Eng.). p.151-61 of "Lead 62." London, Lead Development Association, 1962.

The use of lead and antimony–lead alloys for shielding is discussed. Methods for casting shielded containers are outlined. The bonding of lead to steel and copper and the fabrication of lead sheets are considered. Several workshop practices used for working with lead are described. (C.E.S.)

32954 PRODUCTION OF LEAD BRICKS FOR TEMPORARY AND MOVABLE SHIELDS. G. Vestey. p.163-70 of "Lead 62." London, Lead Development Association, 1962.

Methods for producing lead bricks for temporary and movable shields are described. Gravity casting, gravity casting plus machining, pressure casting, pressure forming and machining, extrusion and machining, and gravity casting and cold pressing are discussed. (C.E.S.)

32955 TITANIUM, ZIRCONIUM AND YTTRIUM HYDRIDES AS SPACE SHIELDING MATERIALS. Robert Van Houten and W. G. Baxter (General Electric Co., Cincinnati). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-362, 7p. $1.00. (CONF-600-40)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

The development of titanium, yttrium, and zirconium hydrides as shielding materials for space nuclear power plants is discussed. Fabrication techniques and engineering design data for these materials are included. Density, hydrogen content per unit weight and unit volume, and normal maximum useful temperature are also given for these materials. (C.E.S.)

REACTOR TECHNOLOGY

General

Refer also to abstract 31912.

32956 (A/CONF.28/P/224) CRITICAL HEAT FLUX CONSIDERATIONS IN THE THERMAL AND HYDRAULIC DESIGN OF WATER-COOLED NUCLEAR REACTORS. S. Levy (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.), J. Batch, and J. Casterline. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Three aspects of critical heat flux (CHF) in water-cooled reactors are discussed: (1) experimental measurements of CHF in circular, rectangular, annular, and multirod geometries, (2) analytical and empirical correlations of CHF, and (3) applications of these predictions to reactor design. The CHF correlations are not satisfactory, especially for complex geometries. Operation beyond CHF is feasible. (D.L.C.)

32957 (A/CONF.28/P/230) FLUID DYNAMICS, STABILITY, AND VAPOR-LIQUID SLIP IN BOILING REACTOR SYSTEMS. Paul A. Lottes (Argonne National Lab., Ill.), William H. Cook, Kenneth F. Neusen, Robert W. Wright, Samuel M. Zivi, and Novak Zuber. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Highlights of two-phase flow research relative to boiling reactors in the U. S. A. are presented. 64 references. (R.E.U.)

32958 (A/CONF.28/P/232) CRITICAL FLOW PHENOMENA IN TWO-PHASE MIXTURES AND THEIR RELATIONSHIPS TO NUCLEAR SAFETY. H. S. Isbin (Minnesota. Univ., Minneapolis), H. K. Fauske, M. Petrick, C. H. Robbins, R. V. Smith, S. A. Szawlewicz, and F. R. Zaloudek. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The expulsion of coolant from pipe and vessel breaks in high-pressure water systems involves metastable and two-phase flow phenomena. A review is presented of analytical studies and experiments on critical coolant loss rates through apertures. Models of the critical two-phase flow were used, and the Fauske, Levy, and Moody models yield flow rates in good agreement with experiment. Blowdown tests on reactor designs and scaling tests are described. (D.L.C.)

32959 (A/CONF.28/P/263) ADVANCEMENTS IN ANALYTICAL METHODS AND MACHINE COMPUTATIONS IN REACTOR PHYSICS DESIGN. E. L. Wachspress (Knolls Atomic Power Lab., Schenectady, N. Y.), R. G. Luce, J. J. Taylor, and G. J. Habetler. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of developments in reactor physics analysis techniques. The structure of the group diffusion equations and advances in numerical methods for their solution, method improvements for obtaining spectral-averaged few-group constants and self-shielding factors, and other adjustments to diffusion equation constants are obtained for a model for the prediction of the steady-state characteristics of a specific reactor configuration. A quasi-steady-state design procedure to estimate core depletion effects is summarized, and variational methods in reactor physics are discussed. 141 references. (R.E.U.)

32960 (A/CONF.28/P/272) STOCHASTIC PROCESSES IN NUCLEAR REACTORS AND MEASUREMENT OF DYNAMIC PERFORMANCE CHARACTERISTICS. Joseph A. Thie. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Methods for using intrinsic stochastic processes or "noise" in reactors to gain information about their dynamic properties are discussed. Zero-power and power reactors are considered. Spatial instabilities in reactors are also considered. (R.E.U.)

32961 (A/CONF.28/P/275) U. S. REACTOR EXPERIENCE AND POWER REACTOR SITING. Clifford K. Beck (Atomic Energy Commission, Washington, D. C.). 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A discussion is presented of the status and trends in site selection criteria, and the reactor accidents and incidents to date are analyzed. The accident record thus far in the 246 reactors of all types operated over a 21-year period has been very good. Increased reliance is being placed on design and engineered safeguards with a corresponding reduction in the isolation distance requirements. (D.L.C.)

32962 (A/CONF.28/P/282) THE NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM IN THE UNITED STATES. J. A. Lieberman (Atomic Energy Commission, Washington, D. C.), H. L. Hamester, and P. Cybulskis. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The nuclear safety research and development programs of the U.S.A.E.C. are outlined. The general objectives are to provide a sound technical basis for location, development, design, construction, and operation of nuclear reactor systems in land, marine, and aerospace environmental applications without undue radiation hazards to the public or to persons engaged in these activities; and to provide increased quantitative assurance to designers, manufacturers, administrators, and the public that this primary objective is being attained. The specific programs discussed are reactor kinetics, fuel-coolant reactions, fission-product behavior, reactor containment, radiation embrittlement of structural steel, fast reactor safety studies, engineering scale safety tests, radioactive waste management, nuclear safety analysis and evaluation, and dissemination of nuclear safety information. (T.R.H.)

32963 (A/CONF.28/P/285) U. S. EXPERIENCE ON THE RELEASE AND TRANSPORT OF FISSION PRODUCTS WITHIN CONTAINMENT SYSTEMS UNDER SIMULATED REACTOR ACCIDENT CONDITIONS. William B. Cottrell (Oak Ridge National Lab., Tenn.), W. E. Browning, Jr., G. W. Parker, A. W. Castleman, Jr., and R. L. Junkins. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Data from fission-product release studies in the U. S. are summarized. These studies have produced data for U, U alloys, UO_2, UC, and BeO–UO_2 as a function of tem-

perature, time, burnup, and ambient atmosphere. Most studies were out-of-pile using induction, resistance, or plasma heating. Characterization of released activity, transport behavior, deposition, and removal from air are the other principal areas of study. Particles identified range from 0.004 μ I_2 vapor to 250 μ UO_2. Fission-product removal studies utilizing sprays, scrubbers, scavenging, and filtration have been quite extensive. These investigations are continuing and are being supplemented with larger scale studies such as Nuclear Safety Pilot Plant, Loss of Flow Test, and Containment Systems Experiment. These will demonstrate the validity and limitations of extrapolations of the lab data. 147 references. (T.R.H.)

32964 (GEAP-4291) MARITIME LOOP IRRADIATION PROGRAM. S-I-5-B-M FUEL IRRADIATION WATER CHEMISTRY FINAL REPORT. D. W. Danielson, R. S. Gilbert, and G. E. Panter (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Aug. 1, 1963. Contract AT(04-3)-189. 65p.

Water chemistry methods and equipment developed for use with the Maritime Loop Irradiation program conducted in the GETR are reviewed. Special emphasis is given to areas having general application to other high purity water systems. Specific conductivity and pH in high purity water systems are discussed. Gross activity levels on coupons of two different surface finishes exposed in the loop coolant system for various time intervals are reviewed. Analytical methods such that the analyses could be performed at the loop location by loop operators are described. (N.W.R.)

32965 (GEAP-4603) PROGRAM FOR THE DEVELOPMENT OF PLUTONIUM RECYCLE FOR USE IN LIGHT WATER MODERATED REACTORS. Twelfth Quarterly Report, January 1–March 31, 1964. M. A. Robkin (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Apr. 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 12p. (EURAEC-1044)

Work has begun to sample the fuel from the pins irradiated to 1800 and 5000 Mwd/t. Examination of the autoradiographs of the unirradiated fuel showed that in a volume of fuel equivalent to a pellet there were 13 hot spots larger than 15 mils. Evaluation of these hot spots with the fuel analyzer showed that they contained about 14 mg of PuO_2 or about 9% of the total plutonium present. The EPITHERMOS code is being modified to automatically normalize the epithermal scattering to the correct value for all moderators. Calibration of the flux wires was made and the reduction of the data from the VBWR irradiation is nearly complete. A similar resonance activation was made in the water reflector of the Stanford Pool Reactor to obtain the relative activity in a well-defined pure water spectrum. Reduction of these data is in progress. (auth)

32966 (HW-SA-3355) AUTORADIOGRAPHY: A TOOL FOR INVESTIGATING REACTOR COOLANT SYSTEM CONTAMINATION MECHANISMS. Lyle D. Perrigo and W. E. Taylor (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [June 3, 1964]. Contract AT(45-1)-1350. 14p. (CONF-446-8)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Techniques and results are presented for radioautographic examination of carbon steel primary coolant loops in pressurized water reactors to determine contamination mechanisms, decontamination effectiveness, and film tenacity. (R.E.U.)

32967 (NAA-SR-Memo-9776) PRESENTATION ON STATUS OF TECHNOLOGY OF ORGANIC COOLED HEAVY WATER MODERATED REACTORS. C. A. Trilling (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 20, 1964. Contract AT-11-1-GEN-8. 25p.

A review is presented on the technical status of and operating experience with organic coolants for heavy water-moderated reactors. (R.E.U.)

32968 (ORNL-P-20) AN ASSESSMENT OF CERTAIN AVENUES OF IMPROVEMENT FOR NUCLEAR DESALINATION TECHNOLOGY. R. Philip Hammond (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 12p. (CONF-612-1)

From IAEA Panel on Use of Nuclear Energy in Saline Water Conversion, Vienna, Apr. 1964.

Analytical considerations are given of some areas of possible improvements in dual-purpose and water-only plants. The effects of product ratio (water to electricity) on the optimum turbine exhaust temperature, performance ratio, and cost of water were determined for several cases and are presented graphically. The effects of a power subsidy on the water costs were also determined. The use of a steam turbine to drive a vapor-compression evaporator in a water-only plant and the use of a single pressure vessel for both the reactor and evaporators in a dual-purpose plant are suggested. (D.L.C.)

32969 (TID-8200(10th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1964. (Division of Reactor Development, AEC). 32p.

Information is presented in tabular form on reactors and critical facilities: civilian reactors, military reactors, production reactors, reactors for export, and critical assemblies. Information given includes designation, location, principal contractor, type, power, and dates of operation or planned operation. (R.E.U.)

32970 SOME NONLINEAR PROBLEMS OF THE NUCLEAR REACTOR THEORY. O. B. Moskalev. At. Energ. (USSR), 16: 304-9(Apr. 1964). (In Russian)

An approximation method was derived for determining the correlation between the bulk temperature of a reactor and the neutron flux, examining in particular the stationary nonlinearity due to the flux-dependence of the cross section. The heat generated within the reactor is a function of the neutron flux; the problem is solved by using equations with temperature-dependent coefficients. The one-group diffusion equation for the neutron flux in a given point of the space was used to illustrate the effect of the non-linearity on the critical conditions of the reactor. On the basis of the critical temperature profile within a cell, the thermal neutron cross section was calculated, after which the critical conditions were determined, assuming that the cross section depends on the temperature distribution throughout the volume of the reactor. The reactor's temperature may be calculated from the heat generation and heat removed rates within it. As a concrete example, the conditions prevailing in a flat homogeneous reactor were calculated, using the perturbation theory. The approximation values obtained were compared with the exact ones and the conditions under which the approximate temperature profile agrees with the actual situation were defined. (TTT)

32971 TRANSIENT CONDITIONS PREVAILING IN A REACTOR DURING RELOADING WITH FUEL ELEMENTS. V. Bartosek (Inst. of Nuclear Investigations, Czechoslovak Academy of Sciences, Rez). At. Energ. (USSR), 16: 315-24(Apr. 1964). (In Russian)

The continuous reloading of fuel elements presents the advantage that the elements reach the same level of burnup

and the reactor itself reaches an equilibrium state. However, this situation does not prevail at the time of the first complete loading of the reactor with fresh elements; therefore the transition toward this equilibrium state was examined, considering in particular the loading and its effect on the reactivity, with special attention to the correlation between the duration of the transient state determined by the radiation stability of the fuel elements and the reloading rate required under various operating conditions. It was assumed that reloading of a single fuel element causes only a negligibly small jump in the reactivity of the whole reactor in comparison with the total burnup reserve and that the neutron flux distribution remains constant and independent from the burnup at a given point. The advantages and disadvantages presented by operating the reactor under uniformly changing conditions, delayed reloading, reloading at a constant rate or at a constant reactivity and various combinations of these conditions were evaluated. Operation of the reactor resulting in an efficient utilization of the reserve reactivity, as compared with uniform irradiation was also examined, plotting the changes in the multiplication factor of the system under various conditions. (TTT)

32972 PRESSURE LOSS IN SUB-COOLED VAPOR FOR HIGH SYSTEM PRESSURE AND HEATING SURFACE LOAD. A. Rauber (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 6: 109-15(May 1964). (In German)

The accurate knowledge of the increase of the pressure loss is necessary for the interpretation of pressurized-water reactors when sub-cooled vapor is introduced into the hottest cooling channels of the reactor. Pressure loss measurements for sub-cooled vapor were carried out on a vertical ring channel with 19 mm exterior diameter and 10 mm interior diameter. Water flowed through the ring channel. Heating surface loads up to 300 w/cm^2, system pressures up to 120 atmospheres absolute, and coolant velocities up to 10 m/sec were used. At the boundary surface of the ring channel were drawn stainless steel tubes whose inside surfaces were heated. The coolant water was continuously degassed and desalted. The experimental installations and the measurement methods are described. The results are then reported and discussed. A dimensionless equation is given which describes the pressure loss in sub-cooled vapor in the areas studied. The results for pure water current without vapor agree with the measurement values from the literature, but the results for sub-cooled vapor can be represented sufficiently accurately by no formulas previously reported. (tr-auth)

32973 THE NUCLEAR REACTOR. Alan Salmon. Methuen's Monographs on Physical Subjects. New York, John Wiley & Sons, Inc., 1964. 144p. $3.00.

Basic concepts in the theory and operation of reactors from nuclear fission to the physics of control are discussed. (R.E.U.)

Auxiliaries and Components

32974 (A/CONF.28/P/227) PROBLEMS IN THE DESIGN AND CONSTRUCTION OF LARGE REACTOR VESSELS. A. L. Gaines (Combustion Engineering, Inc. Nuclear Components Dept., Chattanooga) and L. Porse. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Design requirements for reactor pressure vessels for boiling and pressurized plants of 250 to 1500 Mw(e) capacity are discussed. Construction codes ASME Section VIII and Section III are compared. (R.E.U.)

32975 (A/CONF.28/P/228) COMPONENTS FOR SODIUM REACTORS. H. O. Monson (Argonne National Lab., Ill.), F. A. Smith, W. J. Hallett, and J. J. Morabito. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The design and performance of major components, such as steam generators, heat exchangers, reactor vessels, and pumps of sodium reactor systems are discussed. Recent operating experience, difficulties encountered, and necessary corrective modifications are described. (P.C.H.)

32976 (A/CONF.28/P/245) NONDESTRUCTIVE TESTING OF NUCLEAR REACTOR COMPONENTS. Warren J. McGonnagle (Southwest Research Inst., San Antonio). 9p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Some of the significant research and development in nondestructive testing by various U. S. Atomic Energy Commission agencies and contractors since 1958 are summarized. The methods of nondestructive testing discussed include fuel assay, thermal testing, penetrating radiation (x rays, gamma rays, and neutrons), ultrasonics, and eddy currents. A nondestructive testing system for evaluating fuel element cores is described. (N.W.R.)

32977 (A/CONF.28/P/260) RECENT ADVANCES IN REACTOR SHIELDING IN THE UNITED STATES. Everitt P. Blizard (Oak Ridge National Lab., Tenn.) and Phillip S. Mittelman. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Theoretical and experimental methods of evaluating reactor shields are discussed. Some Monte Carlo computer programs in use in the U.S.A. are reviewed. (R.E.U.)

32978 (GA-5128) SHADOW SHIELDING OF A NUCLEAR REACTOR: EFFECT OF REACTOR SHAPE ON WEIGHT OF SHIELD. W. G. Homeyer (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 24, 1964. Contract AT(04-3)-167. 10p.

A study was made of the weight of a shadow shield required for a reactor to be used in space. Shield weight was calculated as a function of the diameter of the reactor in order to determine the reactor configuration that would minimize the weight of the shield. An approximate general relation was derived from which the optimum reactor dimensions can be calculated for reactors and shields for space applications. (auth)

32979 (HW-SA-3361) SOME DEPOSITION REACTIONS IN REACTOR COOLANT SYSTEM HEAT EXCHANGERS. L. D. Perrigo (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 3, 1964. Contract AT(45-1)-1350. 9p. (CONF-446-9)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

One phase of the investigation of reactor coolant system contamination mechanisms at Hanford has been centered on determining the behavior of coolant borne radioactive species under conditions of heat transfer. Heat exchanger tubes were used since they have been readily available. Preliminary work with these specimens showed that there were pronounced variations in the radiation intensity in the area in which there was a marked change in primary coolant temperature. Supplemental work with autoradiography revealed the existence of precipitated deposits in these horizontal tubes. Following these initial discoveries more elaborate tests were begun. The results of these advanced studies are presented. The detailed investigation of

the effects of heat transfer on system contamination was conducted on tubes removed from a primary heat exchanger of an in-reactor carbon steel loop. This heat exchanger had been in use for over three years. The operating conditions were: 280°C inlet temperature with high-purity water (pH adjusted to 10.0 ± 0.1 with LiOH). Normal operation resulted in turbulent flow; the Reynolds Number was 70,400. (auth)

32980 (IITRI-8262-6) STUDIES OF REACTOR CONTAINMENT STRUCTURES. Bi-monthly Progress Report. R. L. Chiapetta, C. J. Costantino, P. G. Hodge, S. A. Morse, and M. A. Salmon (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Aug. 21, 1963. Contract AT(11-1)-578. 30p.

The development and design of reactor containment structures are studied. Information is given on: dynamic response of cylindrical shells with either rigid or hemispherical end closures, effect of reinforced openings on the strength of cylindrical vessels, approximate theories for the burst strength of finite cylinders and spheres, bulging of pressurized cylinders, plastic deformation and strain hardening effects on shells, and load-deformation relations for flat plates, spherical caps, and cylinders with openings. (N.W.R.)

32981 ON AUTOMATIC START-UP OF REACTORS. Shigeyuki Takamatsu and Yoshizo Takahashi (Tokyo Shibaura Electric Co., Ltd.). Elec. Power (Kyoto), 47: No. 10, 12-17(Sept. 1963). (In Japanese)

A digital control system for automatic reactor startup is described. The system works so that $n_0T_0/T + n - n_0$ is always zero, where n is the reactor power, T is the reactor period, and n_0 and T_0 are the set points of n and T. It is pointed out that the principal difficulty is in making a compromise between the quick response of the control system and the minimization of the fluctuation in the period signal. A system applied to the automatic startup of TTR (a 100-kw swimming-pool type reactor) is described in detail. In this system are used three different values of T_0, i.e., 32 sec for the low-power range, 64 sec for the intermediate, and 128 sec for the high. When T_0 is large, the variation in the measured period is also large, but the power rises slowly and a less quick response is needed for the control system. Therefore, the system time constant was set at 32 sec for T_0 = 128 sec, 16 sec for T_0 = 64 sec, and 8 sec for T_0 = 32 sec, respectively. This choice of the time constants made it possible to keep the standard deviation of the measured period at less than 30%. The system worked successfully over 6 decades variation of the reactor power. (NSA of Japan)

32982 PROCESS TUBE AND FUEL HANDLING CARRIAGE (Engineering Materials). (General Electric Co., Richland, Wash.). (CAPE-1097)

This package contains 12 drawings. For a listing of individual titles, see the Engineering Materials List (TID-4100). This stainless steel carriage is used under water for hot fuel element handling and disassembly. A ratiomotor drives a 7.5 in. by 4 in. cable reel on which the wire rope is stored. The carriage is approximately 18 × 9 × 5 ft. (M.C.G.)

32983 IMPROVEMENTS IN NUCLEAR REACTORS AND IN NUCLEAR FUEL ROD ASSEMBLIES FOR GAS-COOLED NUCLEAR REACTORS. George Frederick Stanley Reising and Christoph Steinert (to Babcock and Wilcox Ltd.). British Patent 961,661. June 24, 1964. Filed Mar. 31, 1960.

A fuel rod assembly for gas-cooled reactors is described. The fuel rod assembly consists of a support member providing two spaced side walls between which gas may flow axially from one end of the support member to the other and a plurality of fuel rods supported at each end by the side walls. The fuel rods are oblique to the axial direction of gas flow through the support member. (C.E.S.)

32984 APPARATUS FOR COOLING TELEVISION CAMERAS, PARTICULARLY IN NUCLEAR REACTORS. Peter Barratt (to Pye Ltd.). British Patent 961,832. June 24, 1964. Filed Apr. 29, 1960.

A means for cooling television equipment that is used for the internal inspection of reactors is described. The television equipment is cooled by jackets of semiconductor materials in which the Peltier effect is produced. The cooling jackets consist of alternate rings of p-type and n-type semiconductor materials connected in a series circuit. (C.E.S.)

32985 NUCLEAR REACTOR CONTROL ROD CONTROL SYSTEMS. Elton John Perks (to Sperry Gyroscope Co., Ltd.). British Patent 961,927. June 24, 1964. Filed Nov. 6, 1959.

A control system for reactor control rods in which the combined inertia of the rotor of the motor and its mechanical coupling to the rod is minimized while still maintaining high torque output at low speeds is described. The motor has a mechanical driving connection with the rod through gearing and the combined inertia of the rotor and the gearing is made sufficiently low to enable the rod to fall rapidly under the action of its own weight to a shutdown position when the motor is de-energized. (C.E.S.)

32986 IMPROVEMENTS IN OR RELATING TO COOLING CIRCUITS FOR LIQUID MODERATOR NUCLEAR REACTORS. Didier Costes (to Commissariat à l'Energie Atomique). British Patent 962,240. July 1, 1964. Priority date June 17, 1960, France.

A cooling circuit for a liquid moderator of a reactor is designed with an independent circuit for a heat-carrying fluid, the fluid circulating in pressure tubes located in a moderator tank containing fissile material and removing the greater part of the heat from the fissile material. The cooling circuit comprises a condenser, at least one channel connecting the moderator tank to the condenser for admission of vapor, and a second channel connecting the condenser to the moderator for gravity flow of the condensate. (L.B.S.)

32987 IMPROVEMENTS IN OR RELATING TO FUEL ROD SUPPORT GRIDS. Henry Lloyd and Robert James Haslam (to United Kingdom Atomic Energy Authority). British Patent 962,266. July 1, 1964. Filed June 13, 1961.

A grid-like strip metal fuel rod support designed to minimize restraint of coolant flow is described. The support structure is formed as a sector, each sector adapted to locate six fuel rods and a plurality of sections assembled to form a circular grid. The design is particularly suitable for a steam-cooled reactor with uranium dioxide fuel. (L.B.S.)

32988 IMPROVEMENTS IN AND RELATING TO MODERATOR CORE STRUCTURES FOR NUCLEAR REACTORS. Arthur Shillitto and Walter Rose (to the English Electric Co. Ltd.). British Patent 963,145. July 8, 1964. Filed Dec. 21, 1959.

A description of the design of a moderator core structure of the kind consisting of an assembly of vertical columns, each column being made up of a plurality of

moderator blocks with some of the blocks maintained in concentric relation with each other by interlocking castellations of end faces, is given. (L.B.S.)

32989 IMPROVEMENTS IN AND RELATING TO LATCHING MECHANISMS PARTICULARLY FOR THE CONTROL RODS OF NUCLEAR REACTORS. Edmond William Searing and Anthony John Trenfield Court (to United Kingdom Atomic Energy Authority). British Patent 963,215. July 8, 1964. Filed July 16, 1960.

An automatic latching mechanism consisting of a movable member along a passage, at least one additional detent member, actuating member and biassing means, both or all of the detent members cooperating to permit or prevent movement of the movable member, is designed. The mechanism provides that a control rod housed in a vertical channel of a reactor can be held above the reactor core until such time as its release is required. It also provides means to effect automatic cocking so that after returning the control rod to its position the mechanism can trip to latch the control rod in that position. (L.B.S.)

32990 DEVICE FOR THE DISTRIBUTION OF THE COOLING FLUID IN A NUCLEAR REACTOR HAVING SEVERAL REGIONS. (to Commissariat à l'Énergie Atomique). French Patent 1,291,633. Mar. 19, 1962. Filed Mar. 10, 1961.

In large breeder reactors usually a central region contains the fissile elements, while breeder elements are disposed in a marginal region. The power density in the central region is essentially higher than that of the marginal region, so that the cooling of the central region has to be more intensive. A liquid-metal coolant can be fed from below to the bottom grid of the reactor core and divided into two portions, feeding the central and the marginal region of the reactor. The distribution means consists of an inner cylindrical casing reaching into a central feeding duct and extended up to the supporting grid by a dividing wall, while an outer cylindrical casing is connected to the end of the feeding duct so as to form between the casings an annular interspace provided with a set of fins mounted one after another on the outer casing. (TTT)

32991 DEVICE FOR HEATING THE COMPONENTS CONNECTED WITH A NUCLEAR REACTOR, USING LIQUID METAL AS A COOLANT. (to Commissariat à l'Énergie Atomique). French Patent 1,294,154. Apr. 16, 1962. Filed Mar. 10, 1961.

In nuclear reactors cooled with a liquid metal having a melting point higher than the ambient temperature, e.g., with sodium (melting point 97°C), it is necessary, before putting the sodium into the reactor, to heat the reactor components to an appropriate temperature. This can be done by covering the reactor components with an outer fluid-tight protective casing adapted to retain possible sodium escapes and providing an interspace through which hot fluid may be led for heating the components. This interspace may be subdivided into several compartments, which may independently be fed by the heating fluid, such as nitrogen. Each compartment contains a means for detecting escaped liquid sodium. These means are sparking-plug like electrodes disposed at the lowest level of each compartment, so that they may be short-circuited by the sodium. (IIB)

32992 IMPROVEMENTS RELATING TO FLUID FLOW LIMITING MEANS, ESPECIALLY IN THE CHANNELS OF A NUCLEAR REACTOR. (to Commissariat à l'Énergie Atomique). French Patent 1,294,274. Apr. 16, 1962. Filed Apr. 13, 1961.

In order to limit the speed of the escaping coolant in the case of a tube burst in a gas-cooled pressure tube reactor, venturi nozzles were inserted preferably in the inlet and or the outlet ducts of each pressure tube. The speed of flow in the narrowest cross section of the venturi is limited to the sound velocity of the gas in this cross section, while during the normal working of the reactor these venturi nozzles only produce a small pressure loss in the cooling circuit. The cross sections may be regulated by adjusting needles. (IIB)

32993 MODULAR CORE UNITS FOR A NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,303,686. Aug. 6, 1962. Priority date Aug. 26, 1960, United States.

A nuclear reactor core is constituted by a plurality of similar modular core units, each adapted to be removed independently from the core and comprising a distinct coding system. These units are each formed by an assemblage of a central cooling channel through the fissile material, in which the primary coolant flows, and of pieces of solid moderator disposed in heat exchange relationship with the channel. The whole unit is covered with a thermal insulating material, so that most of the heat developed within the moderator flows to the central cooling channel. An auxiliary coolant, preferably a gas, flows through the interstices between the modular units so that an appropriate thermal equilibrium may be realized. (IIB)

32994 CONTAINMENT SHELL FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,304,928. Aug. 20, 1962. Priority date Nov. 2, 1960, Great Britain.

Because, in the first phase following a pressure vessel burst, the radioactive contamination of the escaping fluid is relatively low, and in order to avoid constructions that are too expensive, a containment shell was designed that is not fluid tight at pressures higher than a certain value. Therefore reactor coolant may escape from the shell during this first phase, while the vessel is tight at lower pressures in order to retain the contaminated fluid which might escape during a later phase. The space within the containment shell is extended by chimney-stalks provided at their upper ends with valves. The closures rest by their own weights on valve seatings and are lifted from these seatings if the pressure within the containment shell reaches too high a value. (IIB)

32995 NUCLEAR REACTOR OPERATING PROCESS. (to Shell Internationale Research Maatschappij N. V.). French Patent 1,307,615. Sept. 17, 1962. Priority date Dec. 8, 1960, Netherlands.

Organic coolants were previously proposed for nuclear reactors, but their instability against the effects of radiation presented a problem. It was discovered that the speed of formation of bituminous residues of high boiling point decreases when the percentage of these residues increases. Therefore an organic coolant with between 20 and 50% residue was tested. The coolant is heated in the reactor and passes a heat exchanger wherein steam is produced. This steam goes to a superheater working with the heat developed by combustion of a portion of the organic coolant extracted from the reactor cooling circuit. The quantity of extracted coolant is continually replaced by fresh coolant. (IIB)

32996 AUXILIARY COLLECTING TANK FOR BOILING WATER REACTOR INSTALLATIONS. (to Licentia Patentverwaltungs GmbH). French Patent 1,317,167. Dec. 26, 1962. Priority date Mar. 14, 1961, Germany.

Installations with boiling water reactors have an auxiliary

condenser, which is put in action if the functioning of the main condenser is disturbed. Such auxiliary condensers, however, cannot condense steam sooner than a few seconds after the starting signal is given. A tank was designed for collecting the steam produced by the reactor during that short time. This collecting tank is a pressure vessel partially filled with water, the rest of the tank space being occupied by air. The steam coming from the reactor is led into the water within the tank via appropriate injection-nozzles. (IIB)

32997 IMPROVEMENT IN NUCLEAR REACTOR VESSELS. (to Foster Wheeler Ltd.). French Patent 1,317,193. Dec. 26, 1962. Priority date Mar. 13, 1961, Great Britain.

Nuclear reactors have one or several shields or protecting shells disposed between the reactor core and the pressure vessel wall in order to protect the vessel from radiation and heat developed within the core. An arrangement of these shields in a removable manner along several concentric cylinders encircling the reactor core is described. These shields are each composed of several segments adapted to be removed from and to be introduced into the reactor through an opening sufficiently large for the passage of the reactor core but too small for passage of the shielding on in its assembled state. The segments constituting a shield are assembled at joining surfaces, which avoid any radial passage of radiation between them. The lower ends of the segments forming a shield are bent to the vessel axis following the form of the vessel bottom and fit into vertical slotted plates radially disposed like a beam of rays centered in the vessel axis. The concentric shields are spaced from each other by centering ribs disposed at the lower and upper extremities of the cylindrical portion of the shield. (IIB)

32998 IMPROVEMENTS RELATING TO A GAS TURBINE-COMPRESSOR SET FOR PROVIDING A FLUID FLOW IN A CLOSED CIRCUIT. (to Power Jets (Research and Development) Ltd.). French Patent 1,317,561. Jan. 2, 1963. Priority date Mar. 13, 1961, Great Britain.

Gas turbine-compressor sets are known for providing a flow of a radioactive fluid in a closed circuit. Such sets especially adapted for use in nuclear reactor installations serve for the circulation of the primary fluid between the reactor core and the heat exchanger. An outer pressure casing, closed at one end, was connected at its other end to an inlet duct for the fluid coming from the heat exchanger. An outlet duct branched from the side wall of the casing for connecting the set with the reactor. The ducts were each provided with coaxial inner ducts for the flow of hot fluid from the reactor to the turbine and from there to the heat exchanger, while the annular interspace between the coaxial ducts serves for leading the cold fluid from the heat exchanger to the compressor and from there back to the reactor. The set may be exchanged as a whole. (IIB)

32999 RADIATION SHIELDING DEVICE FOR NUCLEAR REACTORS. (to Brown, Boveri and Cie AG and Beteiligungsund Patentverwaltungs GmbH). French Patent 1,317,564. Jan. 2, 1963. Priority date Apr. 5, 1961, Germany.

For shielding gamma rays emitted from the core of a nuclear reactor a certain weight of shielding material largely independent of the material used is necessary. It may happen, that even with a shielding material of the highest specific weight the available space is too small, e.g., in reactor installations placed in a cavern. In such installations it may be necessary for operators to pass through the compartment in which the reactor is placed to enter the compartment behind the reactor. A shielded carriage was designed, which rolls on rails and is adapted to protect the operator during his passage through the reactor compartment. The rails within the compartment are mounted below or above the reactor core. In order to perform minor repairs on the reactor, the shielded carriage is provided with manipulators. (IIB)

33000 REACTOR CONTAINER PROTECTED AGAINST THE RISK OF BURST DUE TO AN OVER-PRESSURE. (to United Kingdom Atomic Energy Authority). French Patent 1,322,444. Feb. 18, 1963. Priority date, Apr. 7, 1961.

Nuclear reactors are provided with two containment shells, one placed within the other, both enclose the reactor pressure vessel and the heat exchangers. The inner shell forms the biological shield, while the outer one is a fluid-tight steel shell. To protect the inner shell against the risk of burst due to an excessive pressure within said shell, flap valves are provided that are adapted to allow a fluid flow out of the shell in case the pressure within the shell passes beyond a given value, which is lower than the burst-pressure of the shell. Each valve comprises a seating round an opening in the shell and a lid shaped closing member pivotally mounted and resting by its own weight against the valve seating. Means are provided for maintaining the valve in a closed position against the action of the pressure within the shell. These means are abruptly put out of action in case the pressure passes beyond a certain value. They may comprise a rod holding the closing member against the seating. The rod is of such dimensions that it breaks when the pressure in the vessel surpasses a given value. (IIB)

33001 JOINT OF CROSS-SHAPED CONTROL RODS. (to U. S. Atomic Energy Commission). French Patent 1,328,572. Apr. 22, 1963. Priority date May 24, 1961, United States.

Coupling of a control rod of cruciform cross section with an extension rod of the same cross section is described. The control rod is extended by two T-shaped crossed plates so that the arms of the two T's may engage in corresponding slots provided in extension rod. The top of the T's has a centering cone adapted to fit into a centering hole at the bottom of the crossing of the T-shaped slots. To couple these two rods the control rod is rotated about 45° and moved axially with respect to the extension-rod until the centering cone fits into the centering hole. After that the control rod is turned in opposite direction until the T's of the control rods engage into the slots of the extension rod, where they are retained by elastic means disposed under compression. (IIB)

33002 PROCESS AND DEVICE FOR THE CONTROL OF A NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,329,117. Apr. 29, 1963. Priority date June 5, 1961, United States.

A process and device for controlling a nuclear reactor during the starting period after a shut-down are described for overmoderated reactors. After the shut-down of a reactor the ^{135}Xe poisoning arises, with a peak after the shut-down. The ^{135}Xe disappears (to 99%) after 72 hours. In restarting the reactor again within this period, the ^{135}Xe decay rate is increased by neutron absorption, which increases the reactivity. In order to compensate for this effect an auxiliary control process is provided, which consists of increasing the moderator quantity in the overmoderated reactor, which results in a lowering of the reactivity. The fuel elements of one or several channels are gradually withdrawn from the reactor core in a symmetrical manner with respect to the core center. (IIB)

33003 MODERATOR STRUCTURE FOR NUCLEAR REACTORS COMPRISING COLUMNS OF STACKED UP GRAPHITE BLOCKS. Everett Long, John Tatlock, and John Michael Leithwaite (to United Kingdom Atomic Energy Authority). German Patent 1,165,174. Mar. 12, 1964. Priority date July 1, 1960, Great Britain.

Each of the graphite columns for use as reactor moderator is suspended from a draw hook. By this arrangement the moderator structure is not submitted to pressure. (Gmelin Inst.)

33004 CHARGE MACHINE FOR NUCLEAR REACTORS. Hermann Kumpf, Robert Weber, Johann Ropers, and Johannes Gallwas (to Siemens-Schuckertwerke AG). German Patent 1,165,775. Mar. 19, 1964. Filed June 30, 1961.

The charge machine described is moved over the fuel loading floor with the help of a crane system. It is guided within a supporting frame attached to the crane carriage and can be bolted so that a rigid unit is obtained. For lowering the charge machine the interlocking mechanism is cleared so that the charge machine is arranged like a pendulum. (Gmelin Inst.)

33005 PRESSURE TUBE REACTOR. Horst Michael and Rudolf Roesler (to Siemens-Schuckertwerke AG). German Patent 1,166,389. Mar. 26, 1964. Filed Oct. 22, 1960.

A reactor composed of pressure tubes, which are individually connected to ring headers, is described. The connecting pipes are bended, arranged in parallel, and equally spaced along the circumference of the ring header. The ring header and the main portion of the connecting pipes are located below the plane in which the pressure tube closings are situated. There are accesses for the charge machine between the connecting pipes. (Gmelin Inst.)

33006 2 OUT OF 3 SAFETY CIRCUIT FOR NUCLEAR REACTORS. Borries Wolfram (to Brown, Boveri & Cie AG). German Patent 1,166,390. Mar. 26, 1964. Filed Sept. 28, 1961.

Two out of the 3 channels are provided with time delay members of very different time delaying properties, so that incoming coinciding noise pulses are separated. As the detected noise pulses have a duration of about 10^{-4} sec it was proposed that one member with a time delay of 0.5 msec and one member with a time delay of 1.0 msec be used. (Gmelin Inst.)

33007 METHOD FOR CHARGING NUCLEAR REACTORS AND CHARGE CONTAINER FOR CARRYING OUT THIS METHOD. Arno Mueller (to Babcock and Wilcox-Dampfkessel-Werke AG). German Patent 1,167,990. Apr. 16, 1964. Filed June 19, 1959.

For charging, the whole core is removed as a unit from the reactor pressure vessel and brought into another pressure vessel, which is coaxially arranged to the reactor vessel and can be transported into a position in which the fuel elements may be changed. A shielded vessel for carrying out this method is described. (auth)

33008 NUCLEAR REACTOR CONTROL ROD OPERATING DEVICE. Etienne Filloleau, Marcel Haffemayer, and Jean Maulard (to Commissariat à l'Energie Atomique, Paris). U. S. Patent 3,139,384. June 30, 1964. Priority date June 27, 1961, France.

A control rod drive mechanism for a liquid metal-cooled reactor is described. The mechanical actuator is powered by a variable-speed electric motor. (R.E.U.)

33009 NEUTRON DETECTOR FOR MEASURING THE NEUTRON FLUX IN A REACTOR. Jacob Hendrik Spaa and Kars van Duuren (to North American Philips Co., Inc.). U. S. Patent 3,140,396. July 7, 1964. Priority date Aug. 25, 1959, Netherlands.

A neutron flux measuring device is described that comprises circulating a neutron-sensitive gas through a chamber located in the reactor at the point of interest. (R.E.U.)

Criticality Studies

Refer also to abstract 32725.

33010 (A/CONF.28/P/258) NEUTRON THERMALIZATION AND REACTOR APPLICATIONS. John R. Beyster (General Atomic Div., General Dynamics Corp., San Diego, Calif.), Noel Corngold, Henry C. Honeck, George D. Joanou, and Donald E. Parks. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The analysis of thermal neutron scattering distributions, with the objective of predicting thermal reactor spectra under various spatial and temperature conditions of physical interest, is studied theoretically. Discussions are presented of theoretical procedures for calculating these scattering cross sections, of the experimental tests carried out to assess the adequacy of the procedures, and of the sensitivity of typical reactor calculations to the scattering description. The calculations take into account the chemical and physical properties of the moderator (crystal or liquid, molecule or atom, etc.). (T.F.H.)

33011 (A/CONF.28/P/259) PHYSICS OF FAST REACTORS. R. Avery (Argonne National Lab., Ill.), H. H. Hummel, R. N. Hwang, D. Meneghetti, P. A. Moldauer, A. B. Smith, P. Greebler, and J. B. Nims. 17p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Developments in methods used to study the physics of fast reactors are reviewed. The status of experimentally obtained cross section data and of cross section theory is considered. Some representative values and the methods used to obtain multigroup constants based on the latest microscopic data are presented and described. Experimental results for a representative set of ZPR-III assemblies were compared with calculations based on these latest multigroup constants. The sodium void coefficient and the Doppler effect are discussed. (M.C.G.)

33012 (A/CONF.28/P/264) LATTICE STUDIES IN LIGHT WATER MODERATED SYSTEMS. Glenn A. Price (Brookhaven National Lab., Upton, N. Y.) and Robert L. Hellens. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented of developments in the study of slightly enriched, light water-moderated lattices. Material buckling, fission ratios, resonance neutron capture, and thermal neutron distributions are considered. Representative results are given for 3 wt % $^{233}UO_2$–ThO_2 triangular lattice. (R.E.U.)

33013 (A/CONF.28/P/265) FAST CRITICAL EXPERIMENTS AND THEIR ANALYSIS. F. W. Thalgott (Argonne National Lab., Idaho Falls, Idaho), J. K. Long, W. G. Davey, W. Y. Kato, S. G. Carpenter, H. A. Morewitz, and G. H. Best. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review of Pu- and Th-cycle fast critical assemblies is presented. Operations of ZPR-III, ZPR-VI, the Epithermal

Critical Experimental Laboratory facility, and LAMPRE-I are reported. (T.F.H.)

33014 (A/CONF.28/P/268) LATTICE STUDIES AND CRITICAL EXPERIMENTS IN D_2O MODERATED SYSTEMS. John L. Crandall (DuPont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.), Walter L. Brooks, Irving Kaplan, Francis L. Langford, Jr., and Loren C. Schmid. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is presented, dealing with heavy-water-moderated assemblies, of measurements of buckling and reactivity; calculations of reactivity; detailed measurements and calculations of lattice parameters; determinations of the effects of voids, heterogeneities, and other special features on the physics parameters; and the incorporation of the measured and calculated physics parameters into the design of heavy water reactors. Examples are given. A bibliography of 103 references is included. (T.F.H.)

33015 (A/CONF.28/P/270) POINT REACTOR KINETICS AND STABILITY CRITERIA. Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Point reactor kinetic equations were derived in an effort to illustrate dynamic behavior failures and to emphasize the need for space-time dependent kinetics for meaningful correlations of experimental measurements. A positive of the derivation is the recognition that point kinetics can always be used to answer questions of overall stability or instability. Existing criteria for nonlinear stability were also reviewed to indicate how restrictive they are and then suggest some practical considerations that might bridge the discrepancy between analysis and experience. (P.C.H.)

33016 (A/CONF.28/P/271) SPACE-TIME REACTOR DYNAMICS. S. Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh), A. F. Henry, S. G. Margolis, and J. J. Taylor. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Space-time dynamics of neutrons in assemblies of reactor materials are surveyed and correlated for developments in the U.S.A. since the 1958 Geneva Conference. Basic mathematical theory, approximate methods for numerical solutions, and applications of space-time analysis to various experiments and to xenon spatial stability are discussed. 91 references. (R.E.U.)

33017 (A/CONF.28/P/284) FAST REACTOR SAFETY RESEARCH. W. J. McCarthy, Jr. (Power Reactor Development Co., Detroit), C. E. Dickerman, A. E. Klickman, and R. B. Nicholson. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A study is presented of mechanisms capable of initiating meltdown in fast reactors; the consequences of gross fuel melting; and the energy released by super-prompt-critical assemblies. (T.F.H.)

33018 (CRRP-627) CLOSELY PACKED NATURAL URANIUM–D_2O LATTICES IN ZEEP. D. Hone and A. Okazaki (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Jan. 5, 1956. Reprinted May 1964. 10p. (AECL-1929; CONF-616-1)

From the Reactor Core Conference, Chalk River, Ontario, Can., Jan. 1956.

The capture of leakage neutrons in close-packed natural uranium–heavy water lattices was investigated. (auth)

33019 (EUR-593.e) CONTRIBUTION TO THE THEORY OF THE PULSED NEUTRON TECHNIQUE APPLIED TO FAST MULTIPLYING SYSTEMS. F. Storrer (France. Commissariat a l'Energie Atomique, Paris); and M. Stievenart (Société Belge pour l'Industrie Nucléaire, Brussels). 1964. 22p. (CONF-596-1)

From Conference on the Progress in the Theory of Nuclear Reactors, Karlsruhe, Ger., Apr. 1963.

A novel approach is presented to the theory of the pulsed neutron techniques, when applied to fast neutron subcritical assemblies. The fact that in such a system an increase of neutron energy can only be the result of a fission, and that in such a process the spectrum of the emerging neutrons is independent of the energy of the incident neutron is exploited. This makes it possible to study independently the evolution of the neutrons in each generation, which is similar to that in a nonmultiplying medium, and which is easier to treat since the energy of the neutron can only decrease. Transfer functions are then obtained that can be combined to obtain the overall evolution of the neutron population in the multiplying system. This theory is then applied to some practical examples and particularly to Godiva for which experimental results are available. It is also briefly mentioned that a similar approach can be used for the analysis of static problems, particularly the exponential experiment. (auth)

33020 (EUR-1620.e) SPECTRUM EFFECTS ON LONG-TERM REACTIVITY CALCULATIONS FOR D_2O-MODERATED, ORGANIC COOLED REACTORS. G. Casini, A. Kind, and G. Rossi (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 12p. (CONF-598-1)

From Meeting on Measurements and Calculation of the Influence of the Burn-up on the Reactivity, Risö, Denmark, Sept. 1961.

It is shown that the variation of the long-term reactivity curve for a heavy water moderated organic cooled reactor depends on accurate evaluation of the thermal neutron spectrum. Such an evaluation is obtained by adopting in an appropriate way the two-group approximation as suggested by D. S. Selengut. By this the rethermalization effects due to the scattering interaction of the neutrons with the hot coolant are taken into account. (auth)

33021 (LFEN-N1.12) MESURE D'INDICES DE SPECTRES PAR OSCILLATION. (Measurement of Spectral Indexes by Oscillation). Eduardo Martinho (Portugal. Junta de Energia Nuclear. Laboratório de Física e Engenharia Nucleares, Sacavem). 1964. 42p.

The advantages of the oscillation method over the activation method for the measurement of spectral indices are indicated. The Westcott formalism for the cross sections of thermal neutrons is reviewed. The principles of the oscillation method and the experimental apparatus were reported. The measurements were made on the Minerva Reactor, and the experimental conditions are given. The results are discussed, and it is concluded that the values of α determined by oscillation are comparable to those obtained by the activation method in the vicinity of flux maximum. In an appendix measurement of the effective absorption cross section of Mn and the resonance integral of Mo are discussed. (J.S.R.)

33022 (WAPD-T-1322) PULSED NEUTRON MEASUREMENTS OF SUBCRITICAL LATTICES. E. E. Carroll, Jr., N. Hartmann, and D. Klein (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT(11-1)-Gen-14. 15p. (CONF-587-1)

From American Nuclear Society 1961 Annual Meeting, Pittsburgh, June 1961.

The thermal-neutron time decay constants of a series of reflected, highly enriched, light-water moderated, essentially one-dimensional, subcritical lattices were measured using the pulsed neutron technique. These measurements were compared with values obtained through four-group diffusion theory calculations. Two-group diffusion theory calculations of decay constants for higher harmonic spatial modes were made to examine the possibility of higher harmonic contamination in fundamental mode measurements. A few measurements of harmonic decay constants were made as a further check. (auth)

33023 SOME PROBLEMS OF PULSED-REACTOR DYNAMICS. V. F. Kolesov. At. Energ. (USSR), 16: 309-14(Apr. 1964). (In Russian)

In the Godiva reactor, the pulse was generated by shifting an enriched U rod in the core which contained about 300 n/sec source. Another pulse-generation method, based on a rod passing through the core at a constant velocity, not exceeding 100 m/sec, was examined. It was found that the shape and the maximum of the pulse could be determined by the reactivity introduced after the exponential increase of the power, not being dependent on the fact whether the reactivity was introduced suddenly or gradually; at a given total reactivity, the pulse characteristics depend on the rate of flight of the rod. The largest pulse is obtained under conditions under which the power reaches its maximum at the very moment when the rod contributes the largest amount of activity. The calculations used by the author in a previous study (Atomnaya Energ. 14: 273(1963); NSA 17: 22806) were applied for solving the dynamics equation of a reactor with a constant core, with a rod possessing a reactivity $5.64 \cdot 10^{-4}$ and a flight velocity ranging from 10 to 90 m/sec, considering the case from the time when prompt criticality was reached. For an initial power corresponding to 10^{-6} Mw at the prompt critical point, the optimum velocity was found to be about 54 m/sec. As a result of the flight of the rod, the slow portion of the pulse is decreased by a factor of about 6. The presence of a large neutron source in the core renders this method more safe. Calculations were also made for the determination of the effect of an internal cavity in the reactor on the energy generation after pulsing. It was found that, keeping the average energy generation identical, the maximum temperature and the thermal stresses in the core per 1g of the medium decrease considerably if the size of the internal cavity is increased. (TTT)

33024 SUBCRITICAL EXPERIMENTS ON LIGHT WATER MODERATED SYSTEM. Akira Oyama and Shigehiro An (Tokyo Univ.). J. Fac. Eng. Univ. Tokyo, Ser. A, No. 1, 44-5(Dec. 1963). (In Japanese)

The subcritical facility, light-water moderated and natural-UO_2 fueled, has special arrangements of neutron sources and special operating apparatus so that maximum convenience for experimental research, including the pulsed-neutron experiments, may be secured. The investigations carried out by using this facility are as follows: measurements of the material buckling and reflector saving, influence of the spatial disposition of the neutron sources on the neutron flux distribution, and comparison between the results of foil and counter measurements. (auth)

33025 APPLICATION OF THE METHOD OF ACTIVE AND PASSIVE SURFACES TO THE STUDY OF HETEROGENEOUS URANIUM-LIGHT WATER AND URANIUM-HEAVY WATER SYSTEMS. Charles Mandrin (Universite, Lausanne, Switzerland). Z. Angew. Math. Phys., 15: 317-18(1964). (In French)

The method, which involves dividing the reactor into cylindrical zones and treating each zone by two-group diffusion theory, was used to investigate the variation of the neutron absorption factor β and number η of fission neutrons/absorbed neutron with the moderator used. The spatial distribution of the thermal flux in the moderator of subcritical assemblies (H_2O-metallic U and D_2O-metallic U) with one ring of rods was measured and was found to be in good agreement with the diffusion results. β and η were obtained by analysis of the curves and were found to vary little with the moderator. The thermal flux distribution in a D_2O-U system with several zones was then successfully calculated using these quantities. (D.C.W.)

33026 EXPONENTIAL AND CRITICAL EXPERIMENTS. VOL. III. Proceedings of the Symposium held in Amsterdam, Netherlands, 2-6 September 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. Apr. 1964. 485p. (STI/PUB/79(Vol.III)); (CONF-133). $10.00; Sch 210,-; 60s.stg; F.fr. 40,-; DM 35,- (IAEA).

Separate abstracts were prepared for 16 of the 25 papers included; 9 were previously abstracted for NSA (17: 42006, 42219, 42223, 42229, 42230, 42233, and 42235; 18: 1236 and 7898). (R.E.U.)

For abstracts of individual papers see: 33027, 33028, 33029, 33030, 33031, 33032, 33033, 33034, 33035, 33036, 33037, 33038, 33039, 33040, 33041, and 33042.

33027 CONCEPT OF A FLEXIBLE EXPONENTIAL EXPERIMENT FOR HIGH-TEMPERATURE, GAS-COOLED REACTOR SYSTEMS. H. Gruemm (Osterreichische Studiengesellschaft fur Atomenergie GmbH, Seibersdorf, Austria). p.27-33 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

In HTGR-systems various atom-ratios of fissionable material, fertile material, and moderator are used. The principle of a multipurpose exponential experiment is discussed, which covers this wide range and allows the performance of a variety of exponential experiments of different material compositions using only one type of basic element. The proposed system is especially designed for pebble-bed systems but can easily be modified to simulate systems with cylindrical fuel elements. The fundamental idea is to use coated particles with different diameters (no high quality demands) for fissionable or fertile materials. Therefore, separation of particle mixtures is possible simply by screening. The moderator elements are graphite sleeves with movable covers, which can be put one into the other forming a set of coaxial cylinders. The central cylinders of each set is filled with the desired mixture of spherical fissionable and fertile particles and graphite powder. Various lattices can be simulated by changing the size of the graphite cylinders. The critical arrangement will be set up in a stagnant helium atmosphere and heated up to high temperatures. (auth)

33028 SOME MEASUREMENTS OF THERMAL-NEUTRON SPECTRA. M. J. Poole, P. Schofield, and R. N. Sinclair (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.87-112 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

Complementary programs to determine moderator scat-

tering law and to test its validity through spectrum measurements have been initiated at Harwell. The scattering-law experiments have been largely carried out at Chalk River, while the data processing is done at the Argonne National Laboratory and the analysis and necessary extrapolation from the measurements performed at Harwell. The spectrum measurements fall naturally into two parts. Using time-of-flight spectroscopy a wide range of measurements was made of thermal-neutron spectra in homogeneous poisoned moderators. This work parallels and extends earlier work and serves to check the validity of energy transfer cross sections $\sigma(E' \rightarrow E)$ derived from the scattering law in use. However such an experiment is completely insensitive to the angular dependence of scattering and to that part of the scattering cross section involving no energy change of the scattered neutron, both of which are important in any spatially dependent problem. Accordingly other experiments were undertaken in which spatial or thermal discontinuities were deliberately introduced to make the spectrum depend on the complete scattering law. The first such is the so-called "two block experiment" in which thermal neutrons are allowed to diffuse from a block of graphite at room temperature into a second block whose temperature may be raised to 400°C. Neutron spectra are measured at various positions near to the temperature discontinuity by extracting a beam of neutrons from each position and passing this into a chopper. As a preliminary analysis, "rethermalization cross sections" were derived from the experiment that may be compared with those of Bennet, who performed a similar experiment using energy sensitive detectors. In order to obtain a more detailed comparison, multigroup diffusion-theory calculations are being carried out, using the Chalk River scattering-law data, in an attempt to predict the shape of the energy spectrum at positions in both blocks. A second experiment introduces a spatial discontinuity instead of thermal. A disk of cadmium sufficiently thick to be black to all neutrons below 0.4 ev is fixed centrally in a tank of water, and spectra were measured near to the disk as a function both of position and of direction of travel of the neutrons (relative to the plane of the cadmium). Spectrum measurements in a graphite-uranium lattice, which provide a check on spectrum calculations in reactor geometry, were considered. Many spectrum experiments can be carried out in either critical or subcritical geometry, and some discussion is given of the relative merits of those two methods of approach. (auth)

33029 SUBCRITICAL EXPERIMENTAL WORK AT THE DELFT REACTOR INSTITUTE. H. R. Kleijn, A. W. Van Der Heijden, and H. Van Dam (Reactor Inst., Delft, Netherlands). p.113-25 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

After a brief discussion of the program of the reactor physics division of the Reactor Institute, water- and graphite-moderated subcritical assemblies are described. The subcritical experimental theory is summarized by giving the basic equations. Further corrections are mentioned, which are to be added to the experimentally determined neutron distribution for material buckling determinations. Special emphasis is placed on the fact that when the neutron source used is placed in a pedestal the assembly sees the source in a fictitious position. Methods are given to determine this fictitious source position. (auth)

33030 APPLICATION OF THE PULSED-NEUTRON TECHNIQUE TO CRITICAL AND SUBCRITICAL ASSEMBLIES. M. Sagot, H. Tellier, R. Jacquemart, and J. Kremser (CEN, Saclay, France). p.163-89 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964. (In French)

The pulsed-neutron technique was used in different critical experiments. This technique is particularly interesting since it can be used without altering the reactor structures. Its application requires only a time selector and pulsed sources which, because of their low density, are introduced on a small scale into the reactor or its reflector. The technique can be used to measure the neutron lifetime and calibrate control rods quickly and in perfectly safe conditions. Two different Rubeole cores were studied in a critical experiment with a beryllium–oxide moderator and slightly enriched uranium–oxide fuel, and the negative importance function was measured in different arrays: (a) reduction in the volume of the nonreflected core; (b) introduction of cadmium control rods; (c) unloading of peripheral fuel; and (d) fuel replacement. Other experiments reported (Alize: light water and uranium enriched to 90%; Aquilon: heavy water and natural uranium; Marius: graphite and natural uranium) show that the technique is applicable to natural-uranium reactors. Using a nonportable neutron generator, the same technique was employed to measure graphite diffusion parameters. The buckling range was between 7 m^{-2} and 155 m^{-2} and the following results were obtained: diffusion coefficient $Do = (2.19 \pm 0.03)10^5$ cm^2 sec^{-1}; cooling coefficient $C = (37.9 \pm 4)10^5$ cm^4 sec^{-1}; and graphite anisotropy $D_{\perp\perp}/D_{\perp} = 1.017 \pm 0.008$. These results are compared with those obtained by others. (auth)

33031 MEASUREMENTS OF $\partial\rho/\partial h$ IN A WATER-MODERATED REACTOR BY AN OSCILLATING MODERATOR-LEVEL TECHNIQUE. D. Babala (Kjeller Research Establishment, Norway). p.191-203 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

Measurements of the moderator-level coefficient of reactivity in the Nora reactor were carried out by means of a pneumatic oscillator that varies the moderator height periodically with a trapezoidal wave-form. A detailed theory for this type of experiment was developed which is of value both for interpreting the experimental results and for estimating the accuracy of the method. (auth)

33032 THE IMPULSE RESPONSE OF AN EXPONENTIAL ASSEMBLY. R. E. Uhrig (Univ. of Florida, Gainesville). p.205-40 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

A spatial-dependent transfer function of an exponential assembly with rectangular geometry and the neutron source located at the origin in the middle of one side was derived using diffusion theory and the usual approximations. A pulse of thermal neutrons introduced at the origin is shown to spread out with time in a symmetrical manner about the $z = 0$ plane. However, the variation of amplitude with time at any position along the z axis shows that a peak value of neutron density does move out from the origin with a decreasing amplitude. Although the multiplication and transverse leakage influence the characteristics of the disturbance, it does propagate away from the source in a manner similar to the propagation of neutron waves. The propagation of a thermal-neutron pulse was demonstrated experimentally in 1962 at the University of Florida using a pulsed-neutron source and a "Thermalizer box." However, the method used for the experiments reported was the cross correlation between the psuedorandom binary (off-on) variation of source strength and the resulting variation of neutron density in the exponential assembly. Data are given

for experiments carried out on both light- and heavy-water moderated assemblies using natural uranium. The results are discussed in terms of the theoretical relations derived and the physical phenomena taking place. The validity of the derived relations and the need for considering higher harmonics for various arrangements of fuel and moderator are discussed. (auth)

33033 USE OF THE NEUTRON DIE-AWAY TECHNIQUE TO TEST CONTROL ROD EFFECTIVENESS THEORIES. R. B. Perez, G. De Saussure, and E. G. Silver (Univ. of Florida, Gainesville). p.241-57 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

The calculation of control rod effectiveness is complicated by its dependence on both the neutron energy distribution and the geometry of the assembly. When the theory is compared with experimental results obtained from either reactors or subcritical systems, difficulties arise in the comparison because of the intrinsic complexity of such systems. The neutron die-away technique affords the possibility of having an all-thermal neutron model, in which the neutron energy distribution can be separated from spatial effects. Hence, the geometrical factor of the control rod effectiveness can be studied without regard to the details of the neutron spectrum, and the results compared with a clean, simple experimental setup. The method is based on the fact that in a neutron die-away experiment of the type described, the buckling of the assembly is related to the decay constant of the fundamental mode by $B^2 = (\lambda - \lambda_a)/D$ where λ_a = inverse lifetime of the neutrons in moderator (sec^{-1}) and D = diffusion constant (cm^2/sec). The moderating assemblies used for these experiments were rectangular prisms of beryllium, built in several sizes from small (2.54 cm high, 7.3 cm square) blocks. Three types of cadmium control rods were used: thin 0.476-cm diameter rods; a cruciform-section rod; and hollow "thick" rods 7.3 cm × 7.3 cm cross section. The theoretical schemes tested were (1) Nordheim-Scalettar; (2) Hurwitz-Roe; and (3) Numerical Diffusion Code. The effect of a cruciform absorber was computed by using the Hurwitz-Roe conformal transformation technique and value of 0.0188 cm^{-2} was found for the buckling, which compares with the experimental results of 0.0187 ± 0.0006 cm^{-2}. For the thick rods, both Nordheim-Scalettar and the diffusion code overestimated the experimental results by about 10%. However, the interaction between thick rods was correctly predicted by both methods. For thin rods, the Nordheim-Scalettar technique was extremely accurate. The disagreement found for the thick rods is to be expected when diffusion theory is used to describe the effect of absorbers with cross-sectional dimensions comparable to the neutron mean free path in the moderator. Measurements with rods of intermediate sizes are being carried out to determine the point at which diffusion theory becomes inadequate. (auth)

33034 PULSED AND STATIC NEUTRON MEASUREMENTS IN LIGHT-WATER AND HEAVY-WATER EXPONENTIALS. T. F. Parkinson, R. B. Perez, D. N. Fry, R. H. Hartley, S. P. D. Smith, and N. J. Diaz (Univ. of Florida, Gainesville). p.259-81 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

The exponential experiment has long been used to determine the material buckling of a multiplying medium. More recently, the pulsed-neutron technique has been applied to measure the time eigenvalue λ from which k_∞ may be deduced. The latter method has the potential advantage of requiring smaller lattice samples than the static exponential method. However, to establish the validity of the pulsed method, intercomparisons between the pulsed and the static techniques are needed. Such measurements were performed with both H_2O and D_2O moderators in bare and reflected systems; a tank 1 m in diameter was used for the experiments. To correlate the measured decay constants with pertinent parameters of the system, a modified one-group theoretical model (Model A) was used. Thus λ is given by a simple relation involving λ_0, k_∞, τ, L^2 and B^2 where B^2 satisfies the two-region critical equation. The fast nonleakage probability was represented by Fermi Age theory. The computational scheme involved first estimating the value of the decay constant λ, and then iterating until a value of B^2 was found which was consistent with the critical equation and the boundary conditions. Two other models were also tested: Model B – a two-region, one-group system is assumed in which B_g^2 in the Fermi kernel is taken as the geometrical buckling of the equivalent bare system with reflector savings; Model C – a two-group bare system with reflector savings is assumed. Comparison of the calculated and experimental decay constants indicates that only Model A gives satisfactory agreement. The following conclusions can be drawn: (1) The presence of the reflector has a large influence on the physics of the pulsed system. The expedient of assuming a reflector savings is not generally valid. (2) The value of the decay constant λ is very sensitive to the assumed value of the fast nonleakage probability. The experiments indicate that k_∞ can be determined for small heterogeneous assemblies using the pulsed-neutron technique. Work is currently in progress on hollow uranium rods which permit simulation of organic coolants. (auth)

33035 THE EVALUATION OF BUCKLING AND DIFFUSION COEFFICIENTS FROM TWO-REGION EXPERIMENTS. R. Persson (Aktiebolaget Atomenergi, Studsvik, Nykoping, Sweden). p.289-304 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

The progressive substitution technique, which is described, has the aim of giving the buckling difference between a small test region and the reference lattice surrounding the test region. With voided fuel assemblies one is forced to consider the difference (δD) between diffusion coefficients in the various regions. Using measurements with single fuel assemblies one is able to determine δD experimentally both in the radial and in the axial directions. The method of evaluation discussed can be described as a modified two-group perturbation theory taking perturbed fluxes into account. (auth)

33036 MEASUREMENT OF THE ANISOTROPY OF DIFFUSION CONSTANT IN MEDIA WITH EMPTY CHANNELS. M. Copic, T. Kalin, G. Pregl, and F. Zerdin (Nuclear Institute "Jozef Stefan," Ljubljana, Yugoslavia). p.305-19 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

Using the pulsed-neutron source technique, the diffusion constant was measured in systems with empty channels. Plexiglas was used as the neutron diffusing material. From separate sets of measurements on rectangular blocks the diffusion constants parallel and perpendicular to channels were determined. The average value of the diffusion constant was also obtained experimentally from measurements on cubes. The difference between both diffusion constants, $D_{\perp\perp}$-$D_\perp$, agrees with theoretical predictions inside the limits of experimental errors, yet the average diffusion constant lies systematically below the predictions of Behrens' theory. (auth)

33037 DETERMINATION OF NEUTRON TEMPERATURE USING BORON FILTERS. T. Rzeszot and E. Warda (Inst. of Nuclear Research, Warsaw). p.321-31 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

A method of neutron temperature determination using boron filters is elaborated. The accuracy of the relative measurements was estimated to be ±4°K. By means of this method the distribution of neutron temperatures in the WWR-S reactor core and in a graphite block was obtained. (auth)

33038 SOME EXPERIMENTAL CHARACTERISTICS OF THE GRAPHITE, WATER-MODERATED CRITICAL ASSEMBLY FOR THE SECOND POLISH RESEARCH REACTOR. J. Arkuszewski, R. Bednarz, J. Bouzyk, et al. (Inst. of Nuclear Research, Warsaw). p.333-54 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

A critical assembly for the second Polish Research Reactor, consisting of tubular 20% enriched fuel elements in the water–graphite lattice surrounded by the graphite reflector, was constructed and put into operation. First experimental characteristics of the assembly are presented. (auth)

33039 R.O.S.P.O. ORGANIC-MODERATED CRITICAL FACILITY. G. Bitelli, S. Grifoni, R. Martinelli, and E. Santandrea (CNEN, Rome). p.401-22 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

As a part of the Italian Project for an Organic Moderated Nuclear Power Plant, the National Commission for Nuclear Energy (CNEN) has installed a critical facility, known as ROSPO, planned to perform criticality studies of the nuclear characteristics of cores to be tested in a 60 Mw(t) prototype reactor (PRO). The first core loading consists of MTR-type fuel elements, with flat, 90% enriched, stainless-steel clad plates; the main physical question to be answered concerns the possibility of obtaining, with this core, a proper reactivity excess, in order to compensate for temperature and poisoning effects, and to ensure a convenient lifetime to the power reactor. The variable parameter is the uranium/stainless steel ratio in the fuel element, and the experiments are performed by studying cores where some of the 16 active plates of each fuel element are substituted by dummy (stainless steel) plates. For three of these cores (0,3, and 5 dummy plates per element, respectively), detailed calculations were carried out to obtain flux plots, reactivity effects, and k_{eff} versus number of elements. The calculation was based upon a modified two-group theory that accounts for fissions in the epithermal zone. The following codes were used: THESIS for thermal, and MUFT 4 for epithermal spectra; FLIP 1 (transport theory) and TUT-T5 (Monte Carlo) for fluxes in the unit cell; PDQ-O2 coupled to WANDA 4 (diffusion theory in xy and slab geometries) for reactivities and macroscopic fluxes. The results are shown and compared with those obtained for the same cores by AGIP Nucleare and by the CNEN Bologna Computation Centre; in spite of the analogy of the methods used, large discrepancies were observed, which are thought to derive from differences in the libraries of cross sections. This seems to confirm the necessity of critical experiments as the most valid help in choosing and checking calculation methods, nuclear codes, and libraries. The measurement of k_{eff} versus the number of fuel elements, performed for the three uranium/stainless steel ratios in ROSPO allows a detailed analysis of these problems. (auth)

33040 CRITICAL ANALYSIS OF THE PROGRESSIVE SUBSTITUTION METHOD FOR MATERIAL BUCKLING MEASUREMENTS. G. Casini and J. Megier (EURATOM, Ispra, Italy). p.423-41 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

A critical analysis of the methods of interpretation for progressive substitution measurements is in progress at the Centre of Ispra (EURATOM). These studies are intended for the interpretation of material buckling measurements to be performed in the ECO (Orgel Critical Experiment) reactor starting in 1964. The report deals with the method of interpretation for progressive-substitution measurements by a two-group theory applied to a reflected reactor, the regions of which are supposed to be cylindrical and homogenized. Some of the points analyzed are: (1) limits of validity of the method with increasing differences between the neutronic properties of the test and reference lattices, (2) effect of the cylindrical homogenization as a function of the number of substituted rods, and (3) effect of the approximations in the reflector calculation. (auth)

33041 AN APPLICATION OF HETEROGENEOUS REACTOR THEORY TO SUBSTITUTION EXPERIMENTS. G. Blaesser (EURATOM, Ispra, Italy). p.443-53 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

An interpretation of substitution experiments by heterogeneous theory avoids many difficulties which are typical of the homogenized treatment (as, for example, the determination of the coupling coefficients of the two zones). As a consequence it seems feasible to reduce sensibly the number of substitutions necessary for many experiments. A suitable method for the determination of the fuel element parameters, which enter into the heterogeneous theory, is discussed. There exists a direct relation between these parameters and some quantities that can be measured in oscillation experiments. (auth)

33042 PANEL DISCUSSION. FUTURE TRENDS IN EXPONENTIAL AND CRITICAL EXPERIMENTATION AND THE ROLE OF THEORY. p.457-65 of "Exponential and Critical Experiments. Vol. III." Vienna, International Atomic Energy Agency, 1964.

Subjects included in the summary of the Symposium are: heavy-water reactors, light-water lattices, graphite lattices, fast reactors, and experimental techniques. (R.E.U.)

Design and Feasibility

33043 NUCLEAR REACTOR. Peter Heinrich Erwin Margen (to Aktiebolaget Atomenergi). British Patent 961,827. June 24, 1964. Priority date June 6, 1962, Sweden.

The design of a boiling water reactor is presented that enables the reactor vessel to be comparatively thin-walled as it does not have to take up the full working pressure. The space between the reactor vessel and the pressure vessel is filled with a gas at the same pressure that prevails inside the reactor vessel. Means are provided to keep the steam and the gas separated while simultaneously allowing the steam space and the gas space to be in open communication with each other to maintain equal pressure. (C.E.S.)

33044 IMPROVEMENTS IN OR RELATING TO LIQUID MODERATOR NUCLEAR REACTORS. Didier Costes and Rene Lemaitre (to Commissariat à l'Energie Atomique).

British Patent 962,189. July 1, 1964. Priority date July 27, 1961, France.

A liquid moderator nuclear reactor is designed with a reactor vessel provided with deformable walls to increase the volume available to the moderator and thereby to relieve the pressure, assuring protection against accidental explosion of the pressure tubes. (L.B.S.)

33045 IMPROVEMENTS IN OR RELATING TO LIQUID MODERATED NUCLEAR REACTORS. James Carrie Guild and Leslie Joseph Castle (to United Kingdom Atomic Energy Authority). British Patent 962,311. July 1, 1964. Filed Nov. 26, 1959.

A liquid moderated nuclear reactor, which shows improved core structure features, is described. It comprises a nest of vertically oriented tubes arranged so that outer surfaces of the tubes define a lattice of voids extending through the nest, tubular coolant-conducting channels disposed lengthwise in the voids, nuclear fuel in the channels, and liquid moderator in the tubes. This reactor operates with nuclear fuel of less enrichment than conventional designs and allows a reduced volume of moderator. (L.B.S.)

33046 NUCLEAR REACTOR. Michel Coudray and Pierre Treille (to Societe Indatom). British Patent 962,625. July 1, 1964. Priority date May 28, 1962, France.

A solid moderator, gaseous-coolant reactor is designed with the following advantageous features; an integrated heat-exchange construction; a sectionalized construction of the heat-exchange assembly with provision for rapidly identifying a leaky section of the assembly; and an improved servicing facility in the form of a servicing chamber provided within the pressure enclosure of the reactor but completely shielded from the bulk of the radiation field present during operation and accessible from outside of the shield. (L.B.S.)

33047 NUCLEAR REACTOR. Ronald Tunstall Ackroyd (to United Kingdom Atomic Energy Authority). British Patent 963,161. July 8, 1964. Filed Apr. 13, 1962.

A nuclear reactor is designed wherein neutron moderation is achieved by an equilibrium mixture of a solid acceptor material containing a neutron moderator and the same moderator in a fluid phase. The reactor is adapted for variation of the equilibrium conditions so as to vary the moderator content of the acceptor material. (L.B.S.)

33048 IMPROVEMENTS RELATING TO NUCLEAR REACTORS, ESPECIALLY TO LIQUID MODERATED REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,303,138. July 30, 1962. Filed July 27, 1961.

Means for increasing the safety of liquid moderated pressure tube reactors consist of compartments of limited space disposed within the reactor vessel and having walls adapted to be deformed by pressure peaks arising within the reactor vessel following a burst of a pressure tube. These walls may suitably be disposed in the proximity of the reactor vessel wall at a certain distance from it. These compartments can also be formed by thin walled cushions filled with gas or with a solid damping material and having a ball or cylindrical shape. In case of a cylindrical reactor vessel a marginal region of the vessel space delimited by the vessel wall and an inner dividing wall is occupied by a series of such cylindrical cushions. These cushions have plugs at their ends for guiding them within the marginal space. The reactor vessel can also be made double-walled and the inner wall provided with openings normally closed by elastic bands wound around it. (IIB)

33049 DEVICE FOR LOWERING THE PRESSURE IN CONTAINMENT SHELLS OF NUCLEAR REACTORS. (to Licentia Patent-Verwaltungs GmbH). French Patent 1,303,680. Aug. 6, 1962. Priority date Aug. 26, 1960, Germany.

Reactor pressure vessels are enclosed within a shell adapted to withstand pressure peaks following a burst of the pressure vessel. In order to avoid too expensive constructions, means are provided for flattening the pressure peak. These means comprise a mass of cold water disposed within the shell for quickly condensing the steam escaping from the pressure vessel and heavy masses placed in immediate proximity of the pressure vessel in order to be accelerated by the steam pressure peak, which results in a flattening of this peak when it arrives at the shell wall. Preferably these heavy masses are constituted by tanks filled with the cold water. The tank wall is adapted to burst immediately at the pressure peak to assure a quick condensation of the steam. For the further damping of the pressure peak the inner wall of the shell is lined with a spongy material. (IIB)

33050 NUCLEAR REACTOR COOLED BY A PRESSURIZED FLUID. (to Simon-Carves Ltd. and General Electric Co. Ltd.). French Patent 1,306,796. Sept. 10, 1962. Priority date Nov. 8, 1960, Great Britain.

Gas-cooled reactors with a concrete pressure vessel are considered. Means for cooling the inner surface of such a vessel, which is protected against the hot pressurized cooling gas by a fluid-tight sheet, are described. The sheet is spaced from the inner surface while an auxiliary gaseous coolant flow, independent of the main coolant flow of the reactor passes through the interstice. The pressure of the auxiliary flow is adapted to the pressure of the main coolant flow. Since the latter pressure does not remain the same over the whole protecting sheet, the interstice is subdivided into different regions, each provided with its own independent auxiliary flow, the pressure of which is adapted to the pressure value of the main coolant, acting in the corresponding region on the protecting sheet. (IIB)

33051 GAS-COOLED NUCLEAR POWER REACTOR. Werner Cautius (to Arbeitsgemeinschaft Versuchsreaktor (AVR GmbH)). German Patent 1,165,777. Mar. 19, 1964. Filed May 30, 1962.

A gas-cooled nuclear reactor is described that consists of a core-containing pressure vessel with an upper gas space connected by a gas duct to the upper end of a vertically arranged boiler unit and a lower gas space connected by a gas duct through a fan to the lower end of the boiler unit. The fan is arranged to circulate gas upward through the pressure vessel and downward through the boiler unit. The pressure vessel includes heat exchange surfaces above the core by which the heated gas is cooled down to less than 600°C. (Gmelin Inst.)

Fuels

Refer also to abstracts 31648 and 32033.

33052 (A/CONF.28/P/219) THERMIONIC DIODES FOR DIRECT CONVERSION REACTORS. Ernest W. Salmi (Los Alamos Scientific Lab., N. Mex.), Fred G. Block, George M. Grover, Herman D. Miller, Robert W. Pidd, and Volney C. Wilson. 10p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

An outline is presented of: properties of Cs-plasma diodes; efficiencies and lifetimes of thermionic converters in

nuclear-powerplant environments; in-pile test results on thermionic converters; and descriptions of systems concepts. (T.F.H.)

33053 (A/CONF.28/P/237) THE SOL-GEL PROCESS FOR THE REMOTE PREPARATION AND FABRICATION OF RECYCLE FUELS. D. E. Ferguson (Oak Ridge National Lab., Tenn.), O. C. Dean, and D. A. Douglas. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The production of ceramic fuels by the sol-gel process is described. The process is developed to produce recycle fuel into ceramic powders suitable for vibratory compaction in metal tubes. The process is adapted to the preparation of the carbides and oxides of thorium and thorium–uranium mixtures and to the production of microspheres. (N.W.R.)

33054 (A/CONF.28/P/239) IRRADIATION BEHAVIOR OF METALLIC FUELS. J. H. Kittel (Argonne National Lab., Ill.), T. K. Bierlein, B. R. Hayward, and W. C. Thurber. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The irradiation behavior of metallic fuels for high-power-density research reactors and fast-breeder reactors is reviewed. Two basic types of irradiation damage to metal fuels are recognized: fission-event damage, which can lead to anisotropic growth of the metal usually without a significant change in its volume; and fission-product damage, which in certain temperature regions can lead to a relatively large change in the volume of the metal. The latter effect, commonly referred to as swelling, occurs in all nuclear fuels but in metal fuels at comparatively lower temperatures. The control of these irradiation problems is discussed. The materials studied include: uranium, molybdenum–uranium alloys, uranium–zirconium alloys, fissium–uranium alloys, fissium–plutonium–uranium alloys, thorium–uranium alloys, thorium–plutonium alloys, stainless steel–uranium dioxide dispersions, aluminum-base dispersions containing uranium, and aluminum-base dispersions containing plutonium. (N.W.R.)

33055 (A/CONF.28/P/240) IRRADIATION BEHAVIOR OF CERAMIC FUELS. T. J. Pashos (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.), D. R. deHalas, D. L. Keller, and L. A. Neimark. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The ceramic fuel materials most extensively used and actually tested in reactor applications are evaluated. The review is concerned mostly with fuels containing uranium dioxide followed by those containing plutonium oxides, thorium oxides, other uranium oxides, zirconium oxides, beryllium oxides, aluminum oxides, magnesium oxides, uranium carbides, plutonium carbides, uranium mononitride, uranium monosulfide, and uranium silicides. (N.W.R.)

33056 (A/CONF.28/P/246) PLUTONIUM VALUE ANALYSIS. Eugene A. Eschbach (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The Pu value analysis system (PUVE) was applied to a large number of circumstances for the continuous (graded) fuel cycle. Computed Pu values do not grossly vary for approximately the same Pu compositions, although for a given fuel exposure the Pu compositions are different from one reactor to the next. Degree of moderation, parasitic absorption, moderator temperature, and other factors are represented in integral fashion with lumped terms. By using lumped reactor constants, it was possible to develop a single formula from which plutonium values computed for successive recycle with graded fuel movement can be represented. Data on computed Pu values for four simulated reactors are tabulated. The fuel cost and assigned Pu price for a hypothetical non breeding reactor are also included. (P.C.H.)

33057 (A/CONF.28/P/248) FUEL CYCLE ECONOMICS OF FAST REACTORS. Leonard E. Link (Argonne National Lab., Ill.), George J. Fischer, and Edwin L. Zebroski. 13p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Projected fuel cycle costs for 1500-Mw(e) fast-reactor systems are analyzed. Analytical methods and reference cases are discussed. (R.E.U.)

33058 (A/CONF.28/P/249) ADVANCES IN AQUEOUS PROCESSING OF POWER REACTOR FUELS. F. L. Culler, Jr. (Oak Ridge National Lab., Tenn.) and R. E. Blanco. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Recent advances in the development of aqueous processes for reprocessing power reactor fuels and for the recovery of valuable radioactive materials are reviewed. Information is included on fuel costs, solvent extraction, ion exchange, leaching, extraction equipment, fission product recovery, production capacity, and fabrication rates. (N.W.R.)

33059 (DC-60-1-60) STRESS ANALYSIS OF METALLIC FUEL ELEMENTS—STRUCTURAL MEMO NO. 36. D. R. Riley, B. R. Thompson, and A. Monfort (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 8, 1960. Contract AT(11-1)-171. 113p.

Stresses and deflections resulting from drag loads and differential temperature expansions are calculated for five different concentric ring fuel element configurations. The five configurations are: 102, 103A–9 ring ETR, 103A–15 ring, 103B–reference shell, and 103B–internal support. Calculations are made for each configuration at constant temperature, burner rig, and nuclear operating conditions. Beam (comb) stresses are plotted and cylinder stresses and deflections are tabulated for each configuration operating condition. (auth)

33060 (DPST-64-83-5) USAEC-AECL COOPERATIVE PROGRAM MONTHLY PROGRESS REPORT, MAY 1964. H. S. Hilborn, comp. (Du Pont de Nemours (E. I.) & Co., Savannah River Lab., Aiken, S. C.). June 18, 1964. Contract AT(07-2)-1. 14p.

Irradiation testing of CANDU reactor fuel bundles in the HWCTR is summarized. The burnout heat flux of closely spaced fuel rods in fuel bundles in a heavy water-moderated, light water-cooled power reactor is measured and analyzed. (N.W.R.)

33061 (EURAEC-1077) PLUTONIUM RECYCLING. Quarterly Report No. 14, January 1–March 31, 1964. (France. Commissariat a l'Energie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12 RDF. 4p.

The fabrication and properties of plutonium–uranium fuel elements are discussed. (N.W.R.)

33062 (MIT-2073-1) FUEL CYCLE ANALYSIS IN A THORIUM-FUELED REACTOR USING BIDIRECTIONAL FUEL MOVEMENT (thesis). Ferdinand Hofmann (Massachusetts Inst. of Tech., Cambridge). June 1964. Contract AT(30-1)-2073. 164p. (MITNE-51)

A computer code was written for an IBM 7090/7094 computer to investigate the equilibrium fuel cycle of a thorium-fueled CANDU-type reactor having a radial blanket. The ^{233}U fuel, which is bred in core and blanket, is assumed to be recycled continuously (along with all the higher uranium isotopes contained in it). The blanket is fed with pure ThO_2. For a conversion ratio less than unity, a certain amount of ^{235}U makeup is required to keep the reactor critical. The equilibrium fuel cycle is then characterized by the fact that all nuclides have reached their equilibrium concentrations. The code was used to study the effects of five important variables on the performance of the reactor. The five variables are: the blanket thickness, the lattice pitch, the average fuel burnup, the maximum linear power, and the recycle losses. If all five variables are set equal to the corresponding CANDU design parameters, and a recycle loss of 2.0% is assumed, an overall conversion ratio of 0.789 results. The maximum possible overall conversion ratio that could be achieved by varying the five parameters is 0.924. This value, however, applies to a reactor with a very low power output and a low fuel burnup. The conversion ratio of a CANDU-type reactor could possibly be raised above unity by adding an axial blanket and decreasing the amount of zirconium in the core (pressure vessel design). (auth)

33063 (NP-14078) THE UREA PROCESS FOR UO_2 PRODUCTION (thesis). Marie Egidius Antonius Hermans (Delft, Netherlands. Technische Hogeschool). [1964]. 170p.

The production of uranium dioxide powders for use as fuel for the KEMA Suspension Test Reactor by the urea process is described along with related chemical operations. Special emphasis is given to the preparation of the amorphous precipitate, which is used for the uranium dioxide production. The sulfate process which yields a better product, but which was developed later, is briefly mentioned. The particle size distribution in the urea process is studied with respect to stirring conditions and chemical conditions. Information is also presented on: the influence of the chemical conditions on the precipitate, the influence of the stirrer speed on the crystallization of the amorphous product, the chemistry of the crystallization, x-ray diffraction data, structural relationships, and the application of uranium dioxide from the urea process. Some hydrolytic phenomena of uranyl salt solutions are investigated. Analytical procedures for the urea process are summarized. The use of the fuel in the KEMA subcritical assembly is discussed. (N.W.R.)

33064 (WCAP-1150) AQUEOUS SLURRY ENGINEERING HANDBOOK. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh and Pennsylvania Power and Light Co. Atomic Engineering Dept., Pittsburgh). Mar. 16, 1959. 365p.

This handbook presents all the pertinent technological information on aqueous thoria–urania slurries, which was developed and/or compiled during the PAR project. The book is divided into five sections dealing respectively with fuel problems of slurry homogeneous reactors, properties of the separate components of the slurry fuel system, slurry characterization techniques, properties of slurry systems, and engineering operations with slurry systems. (D.L.C.)

33065 A MINIATURE PILOT PLANT FOR THE REPROCESSING OF NUCLEAR FUELS. PART I. DESCRIPTION AND OPERATION. A. Naylor, W. Baxter, A. Duncan, and A. F. D. Scott (United Kingdom Atomic Energy Authority, Windscale, Cumb., Eng.). J. Nucl. Energy, Pts. A & B, 18: 331-45(June 1964).

A miniature pilot plant is described that was used in the development of a solvent extraction process for the new reprocessing plant for civil reactor fuels in Britain. Details are given of its operation under continuous and highly radioactive conditions. Close control limits were achieved during the trials in which the whole unit, comprising a fuel dissolver and eighteen counter-current contactors, was operated. (auth)

33066 NEW REFRACTORY PRODUCTS, ESPECIALLY FOR NUCLEAR FUELS, AND THEIR METHOD OF MANUFACTURE. Pierre Blum and Philippe Guinet (to Commissariat à l'Energie Atomique). British Patent 963,162. July 8, 1964. Priority date June 21, 1961, France.

The preparation of new refractory fuel products designated by the formulas; XO_2/XN or XO_2/YN, representing the eutectic formed between the oxide and nitride of an element X or between the oxide of X and the nitride of Y, X and Y forming parts of the actinide series; is discussed. These fuels are characterized by higher thermal and electric conductivity than their corresponding oxides and a high resistance to oxidation and to chemical corrosion. Several examples are given. (L.B.S.)

33067 FUEL ELEMENT ASSEMBLY FOR NUCLEAR REACTORS. Norman Bradley (to United Kingdom Atomic Energy Authority). German Patent 1,165,173. Mar. 12, 1964. Priority date June 29, 1959, Great Britain.

The fuel element assembly consists of a tubular housing, through which a coolant medium is circulated, a plurality of lattices attached to the housing and at certain axial distances from each other for centering a bundle of sheathed fuel rods, and sections of thermally insulating nonfissionable material dividing the fuel into separate portions. The sections are brought into an alignment with their corresponding lattice pieces. (Gmelin Inst.)

Power and Power-Breeder Reactors

Refer also to abstract 32031.

33068 (A/CONF.28/P/192) FUTURE ENERGY NEEDS AND THE ROLE OF NUCLEAR POWER. Gerald F. Tape (Atomic Energy Commission, Washington, D. C.), Frank K. Pittman, and Milton F. Searl. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

An outline is presented of the economics and future feasibility of nuclear power plants. (T.F.H.)

33069 (A/CONF.28/P/193) INTERNATIONAL COOPERATION ON NUCLEAR POWER. H. D. Smyth (International Atomic Energy Agency, Vienna and Princeton Univ., N. J.). 13p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The military, industrial, and nationalistic aspects of international cooperation in nuclear power development are outlined. A brief history of this type of cooperation is presented, from the discovery of U fission to the present (1964). (T.F.H.)

33070 (A/CONF.28/P/202) OPERATIONAL EXPERIENCE WITH PRESSURIZED WATER SYSTEMS. Roger J. Coe (Yankee Atomic Electric Co., Boston) and William C. Beattie. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Four pressurized-water power reactors, Shippingport, Saxton, Yankee, and Indian Point, have compiled a total of over 11 plant-years of operating history. Plant characteristics, testing, and commercial operation from July 1961 to March 1964 are described for the Yankee Power Reactor. For the Indian Point Station, plant characteristics, testing, operation statistics for January 1963 through January 1964, performance of the thorium oxide core, power distribution, Core II design, problems with control rod drives, failures of primary coolant pumps, lining sphere canal, leaks in steam generator tube, and crack in main steam lead are considered. Operation of the Saxton and Shippingport reactors is also reviewed. (M.C.G.)

33071 (A/CONF.28/P/203) DEVELOPMENTS IN PRESSURIZED WATER REACTORS. J. C. Rengel (Westinghouse Electric Corp., Pittsburgh) and W. E. Johnson. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The status of pressurized-water reactors already built, under construction, or contracted for the production of electric power for distribution is reviewed. Operating experience with the Shippingport, BR-3, Yankee, and Indian Point reactors is discussed. Technological advances, test programs, developments in layout and components, simplification of plant design, advantages of chemical shim control, concepts of rod cluster control, and improvements in fuel technology are described. Economics of pressurized-water reactors are considered along with future prospects. (M.C.G.)

33072 (A/CONF.28/P/204) OPERATING EXPERIENCE WITH BOILING WATER REACTORS. V. L. Stone (Commonwealth Edison Co., Chicago). 17p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The design and operation of the Dresden, Big Rock Point, and Humboldt Bay Unit No. 3 power reactors are described. Test programs, full-power operation, gaseous and liquid waste disposal, process chemistry, and personnel exposures for all 3 reactors are discussed. Operation of the Dresden station with Core I, partial reactor fueling and turbine inspection, and operation with Core II are reported. The research and testing program for the Big Rock Point Power Reactor is described and the outages listed. The outages and power operation test program for the Humboldt Bay Unit No. 3 are discussed. (M.C.G.)

33073 (A/CONF.28/P/205) DEVELOPMENTS IN BOILING WATER REACTORS. George White (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The status, design trends, and economics of boiling-water-reactor power plants are reviewed. (T.F.H.)

33074 (A/CONF.28/P/206) SODIUM COOLED THERMAL REACTORS. C. Starr (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.) and S. Siegel. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The design, development, and operations of the Sodium Reactor Experiment, Hallam Power Reactor, a large advanced sodium graphite reactor (SGR), and SGR's in general are reviewed. (T.F.H.)

33075 (A/CONF.28/P/207) SODIUM COOLED FAST BREEDER REACTORS. L. J. Koch (Argonne National Lab., Ill.), F. S. Kirn, G. W. Wensch, C. E. Branyan, and E. L. Alexanderson. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A summary of the program for development of fast reactors that will be compatible with electric generating system requirements of the 1980's is presented, with special emphasis on the Experimental Breeder Reactor II (EBR-II), the Enrico Fermi Atomic Power Plant, and major engineering considerations relating to larger, solid fuel, heterogeneous, sodium-cooled fast power reactors. Sodium filling and purification, fuel handling, primary sodium pump removal, low-power operation, and preparation for power operation are described for the EBR-II. Sodium system operation, component repair and modification, fuel handling, low-power operation, and preparation for power operation are discussed for the Fermi Reactor. Design studies for 1000-Mw(e) fast power reactors are described. (M.C.G.)

33076 (A/CONF.28/P/208) SEED AND BLANKET REACTORS. A. Radkowsky (Atomic Energy Commission, Washington, D. C.), G. W. Hardigg, and R. G. Luce. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Developments in the application of the seed-blanket core concept are described, including Shippingport experience and work in the Large Power Reactor Program. Advantages of the seed-blanket concept are listed. Operating experience with Shippingport Core I is summarized. Design of Shippingport Core II is described. Two basic designs using natural thorium blanket are discussed. The potential of the seed-blanket concept for breeding in a light-water system is considered. (M.C.G.)

33077 (A/CONF.28/P/209) HEAVY WATER POWER REACTORS AND ORGANIC COOLED POWER REACTORS. Walter H. Zinn (Combustion Engineering, Inc., Windsor, Conn.) and Charles A. Trilling. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The development of heavy water power reactors is reviewed. Design concepts are discussed and typical installations described. Variations of fuel element geometry for different coolants in heavy-water-moderated reactors are discussed. Results of an economic evaluation for four coolants, liquid D_2O, boiling D_2O, organic, and H_2O, are presented. Operation of the Organic Moderated Reactor Experiment is described. Initial operating experience with the Piqua Nuclear Power Facility is summarized. The status of organic reactor technology and its applications to heavy water reactors are discussed. (M.C.G.)

33078 (A/CONF.28/P/210) DEVELOPMENTS IN SPECTRAL-SHIFT REACTORS. Milton C. Edlund (Babcock and Wilcox Co., Lynchburg, Va.). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Design concepts and physics for spectral-shift control of reactors are discussed. Design features of the Spectral Shift Control Reactor are described. The low-enrichment uranium and the thorium–uranium recycle fuel cycles are compared. A comparison was also made of 1000-Mw(e) spectral-shift and poison control pressurized-water reactors. (M.C.G.)

33079 (A/CONF.28/P/211) PORTABLE REACTOR POWER PLANTS. M. A. Rosen (Atomic Energy Commission, Washington, D. C.), J. B. Roll, and R. D. McFarren. 14p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The history, objectives, design innovations, operating experience, and future applications of U.S. portable power reactors are summarized. The four plants developed in this program which are now operating are pressurized-water with pressures from 1200 to 1750 psi, and all use compact cores of UO_2–stainless steel cermet. Design objectives and characteristics are tabulated, and the PM-1 and PM-3A are examined in detail. Design innovations discussed are the compact core, the heat rejection condenser, packaging, and special waste disposal. (T.R.H.)

33080 (A/CONF.28/P/212) THE U. S. PROGRAM FOR THE DEVELOPMENT OF ADVANCED REACTOR CONCEPTS. Nelson F. Sievering, Jr. (Atomic Energy Commission, Washington, D. C.). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The status of a number of advanced reactor concepts being developed is reported. Work on fluid fuel reactors such as the Molten Salt Reactor Experiment, the settled-bed reactor concept, and the paste-blanket concept is described. Development work on three types of high-temperature gas-cooled reactors, the Experimental Beryllium Oxide Reactor (EBOR), the Ultra High Temperature Reactor Experiment (UHTREX), and refractory metal reactors, is discussed. The thermionic reactor concept and the Medium Power Reactor Experiment are described. (M.C.G.)

33081 (A/CONF.28/P/213) HIGH-TEMPERATURE GAS-COOLED REACTORS. Frederic de Hoffmann (General Atomic Div. General Dynamics Corp., San Diego, Calif.) and C. L. Rickard. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Development of the high-temperature gas-cooled, 40-Mw(e) Peach Bottom Power Reactor is described. Design of the fuel elements of coated uranium and thorium particles in a graphite matrix is shown and fabrication and testing discussed. Reactor construction, physics, materials, and chemistry are considered. Development work on larger HTGR's is reviewed. Fuel cycles and power costs are discussed. (M.C.G.)

33082 (A/CONF.28/P/214) THORIUM UTILIZATION SYSTEMS. James A. Lane (Oak Ridge National Lab., Tenn.), L. G. Alexander, L. L. Bennett, W. L. Carter, A. M. Perry, M. W. Rosenthall, and I. Spiewak. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Conceptual, fuel-cycle, and economic evaluations of Th-breeding power reactors are presented. (T.F.H.)

33083 (A/CONF.28/P/215) DEVELOPMENTS IN NUCLEAR SUPERHEAT. M. Novick (Argonne National Lab., Idaho Falls, Idaho), R. E. Rice, C. B. Graham, D. H. Imhoff, and J. M. West. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The state of the art of nuclear superheaters is reviewed, and the application of nuclear superheat technology in several reactors (BONUS, BORAX-V, Sioux Falls Power Reactor, and EVESR) is described. (T.F.H.)

33084 (A/CONF.28/P/226) THERMAL DESIGN ASPECTS OF GAS-COOLED POWER REACTOR CORES. M. Troost (General Atomic Div. General Dynamics Corp., San Diego, Calif.), P. Fortescue, R. N. Lyon, G. Melese, and G. Samuels. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

General considerations for gas cooling of reactors are discussed, and detailed thermal designs are given for EGCR, HTGR, EBOR, 630-A, ML-1, and UHTREX. 43 references. (R.E.U.)

33085 (A/CONF.28/P/229) IMPROVEMENTS IN INSTRUMENTATION FOR HIGH-PERFORMANCE POWER REACTORS. S. H. Hanauer (Oak Ridge National Lab., Tenn.). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Recently developed instrumentation techniques useful in present and future power reactors are described. Instrument systems are discussed with particular reference to coincidence and testing in safety systems and the coincidence magnet, multiple reactor controllers, and wide-range counting channels. Advances in neutron detectors are outlined under the headings: neutron flux measurements using ion-chamber current fluctuations, electrically adjustable gamma compensation, miniature fission chamber and preamplifier assembly, and subminiature in-core ion chamber. Sensors for non-nuclear variables described are: acoustic thermometer, ultrasonic liquid-foam-vapor height gage, and ultrasonic detection of incipient boiling and cavitation. 24 references. (T.R.H.)

33086 (A/CONF.28/P/247) FUEL CYCLE ECONOMICS OF URANIUM FUELED THERMAL REACTORS. John M. Vallance (Atomic Energy Commission, Washington, D. C.). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Using a set of arbitrary economic and operational assumptions, the fuel cycle costs of various types of nuclear electricity-generating plants, viz. boiling-water, heavy-water, pressurized-water, and sodium-graphite, are calculated. Plant capital costs are ignored. (T.F.H.)

33087 (A/CONF.28/P/266) CALCULATION OF CRITICALITY, POWER DISTRIBUTION AND FUEL BURNUP IN THERMAL POWER REACTORS. G. H. Minton (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh) and H. W. Graves, Jr. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The prediction of performance of a power reactor from calculations of criticality, neutron flux and power distribution, control elements and materials, temperature coefficients, and fuel burnup is discussed. Emphasis is placed on problems encountered in design of low-enrichment, light water-moderated systems. 52 references. (R.E.U.)

33088 (A/CONF.28/P/267) SOME NUCLEAR AND SAFETY CONSIDERATIONS IN THE DESIGN OF LARGE FAST POWER REACTORS. David Okrent (Argonne National Lab., Ill.), K. P. Cohen, and W. B. Loewenstein. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Nuclear performance and safety characteristics of large (1-Gwe) fast power reactors are examined. Several reference designs for 1-Gwe fast power reactors are surveyed. Criteria for Doppler and Na-void reactivity effects are reviewed. (T.F.H.)

33089 (A/CONF.28/P/273) APPLICATION OF DIGITAL COMPUTER TECHNIQUES TO REACTOR OPERATION. M. A. Schultz (Milletron, Inc., Irwin, Penna.) and F. C. Legler. 13p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Uses of digital computers to improve reactor power

plant economics, reliability, and efficiency are discussed. The state-of-the-art in the U.S. is discussed for various functions: data acquisition and alarming, computation of operating parameters, programing of sequential events, diagnostics of malfunctions, and automatic control of loops. (R.E.U.)

33090 (A/CONF.28/P/274) POISON CONTROL OF THERMAL REACTORS. Alvin Radkowsky (Atomic Energy Commission, Washington, D. C.) and Robert J. Creagan. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Soluble poison and burnable poison control methods are described. No attempt is made to compare the two or discuss systems in combination. The soluble poison discussion consists of a brief review of the physics and chemistry aspects of the use of boric acid for chemical shim in closed-cycle water reactors. A general survey of burnable poisons is followed by applications to reactors containing fertile materials. Burnable poisons other than boron discussed are Sm, Dy, Er, Gd, and Eu. Experimental techniques in investigation of burnable poisons are outlined. 20 references. (T.R.H.)

33091 (A/CONF.28/P/276) CONTAINMENT AND ENGINEERED SAFETY OF NUCLEAR POWER PLANTS. W. Kenneth Davis (Bechtel Corp., San Francisco) and William B. Cottrell. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A review is made of containment systems and other engineered safeguards features used or proposed for use with power reactors of U.S. design, with emphasis on light-water-cooled reactors. The containment systems discussed are: pressure, low-pressure, pressure-suppression, pressure-relief, negative pressure, multiple-barrier, and underground. Auxiliary safeguards, consequences-limiting devices to augment containment, are discussed in six groups: core spray and injection, building sprays and fogs, filter systems, iodine removal systems, foams, and accessories such as multiple valves and locks, multiple electrical and piping penetrations, and multiple instrumentation. The importance of reliability in designing engineered safeguards is emphasized. 21 references. (T.R.H.)

33092 (A/CONF.28/P/283) REACTOR EXCURSION BEHAVIOR. W. E. Nyer (Phillips Petroleum Co., Idaho Falls, Idaho), G. O. Bright, and R. J. McWhorter. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Data on reactor excursions is reviewed and applied to power reactor system design. It is concluded that for many reactor types excursion behavior is well understood and the self-limiting capabilities can be sufficient to protect against substantial reactivity disturbances. The effects of locally positive reactivity coefficients and excursions initiated under high power conditions have not been examined. Information on very short period excursions in light water-oxide cores is limited. No data are available to determine a destructive threshold for these cores. 40 references. (T.R.H.)

33093 (ACNP-64014) CONTROL ROD DESIGN REPORT FOR PATHFINDER REACTOR. D. E. Fortunato, R. H. Klumb, and D. A. Patterson (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 29, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 83p.

The design, fabrication, and predicted operation of 2 wt % natural boron-stainless steel control rods for the boiler core and superheater core for the Pathfinder reactor are discussed. Mechanical and thermal tests were performed, and are reported. (R.E.U.)

33094 (ACNP-64024) PATHFINDER ATOMIC POWER PLANT. Technical Progress Report, January–March 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 15, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 23p.

Progress is reported on the development of the Sioux Falls Power Reactor. Information is included on: design specifications for the Controlled Recirculation Boiling Reactor with nuclear superheater, pre-critical testing of emergency condenser, physics testing of enriched boiler fuel elements, instrumentation, fuel loading, criticality testing, and core design. (N.W.R.)

33095 (AD-430158) NIKE X CONVENTIONAL AND NUCLEAR STEAM POWER SYSTEMS STUDY. VOLUME III. AVAILABILITY EVALUATION. Report No. 434. C. J. Oberhauser, P. Goldberg, and E. F. Frankel (Dynatech Corp., Cambridge, Mass.). Jan. 1964. For Stone and Webster Engineering Corp., Boston. Contract DA-49-129-eng-519. 83p. (SW-NIKE-X-6(Vol.III))

The results of an availability analysis of nuclear and conventional steam power plants proposed for NIKE-X missile bases are reported. The general concept of availability is explained and discussed. The method used to analyze the availability of a number of nuclear and conventional steam plants is also reported. Calculated values are given with respect to the power requirements of the NIKE-X system. Recommendations for further studies are included. (auth)

33096 (AECL-1988) MEASUREMENT OF ELLIPTICAL NPD PRIMARY COOLANT PUMP SEAL DEFLECTION. D. G. Dalrymple (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1964. 14p.

An experimental program to investigate the deflection of stationary NPPD elliptical pump seals was undertaken after several failures occurred when the pumps were shut down and maintained at full operating pressure. An optical lever was used to measure the twisting deflection of a seal model at pressures up to 200 psig. It was shown that the seal would deflect more than 25×10^{-5} radian when nearly balanced at a pressure of 1025 psig. This would result in an estimated gap of 10^{-4} inch and high-velocity leakage flow. It was also indicated that subsequent modifications have probably eliminated excessive deflection. The experimental technique described is estimated to have an accuracy of $\pm 10^{-5}$ radians, and can be used on prototype seals. (auth)

33097 (ANL-6789) THE BREEDING RATIO OF A PLUTONIUM LOADING IN EBR-I. R. R. Smith, R. O. Haroldsen, R. E. Horne, and R. G. Matlock (Argonne National Lab., Idaho Falls, Idaho). Feb. 1964. Contract W-31-109-eng-38. 77p.

The measurement of the breeding ratio for the Mark IV core in EBR-I is described. The fourth loading consists of metallic plutonium stabilized with 1.25 wt % aluminum. The fuel elements are described. (R.E.U.)

33098 (CEA-R-2433) LE TRAITEMENT DES INFORMATIONS DANS LES REACTEURS G.2/G.3. (Information Processing in the G2-G3 Reactors). Jose Meiffren (France. Commissariat a l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). May 1964. 24p.

Various equipment used in the G 2 and G 3 reactors at Marcoule for processing information is described. The information concerns for the most part the signals given by the thermocouples placed at each channel exit, as well as certain figures required for the automatic treatment of results that facilitate the rational operation of the reactors. Details are given concerning the operation of these installations (supervision, control or treatment of information), as well as the list of the various programs which may be used in the electronic computer to give an instantaneous reply to the conditions fixed by the reactor operator. (auth)

33099 (CRRP-872(App.7)) FOURTH REFERENCE CANDU REACTOR (CONT'D). D. G. Hurst (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 15, 1964. 11p. (AECL-949(App.7))

The reactor calculations discussed in previous appendices allowed for a dependence of lattice parameters on the ratio of fast to slow flux. The method of allowing for the flux ratio, which was not reported, is described in this Appendix. Some recent calculations show the extent to which this dependence on flux ratio alters the calculated burnup. In the course of the work an inconsistency was removed from the computer program that provides values of the lattice parameters. This correction increased the calculated burnup in the Fourth Reference CANDU reactor from 8807 to 8942 Mwd/t. (auth)

33100 (CVNA-99) DEVELOPMENT OF PRESSURE TUBE SEAL WELDING AND CUTTING EQUIPMENT FOR CVTR. A. Selz and L. P. Hornak (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Mar. 1964. For Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C. Contract AT(30-1)-2289. 54p.

Includes Appendices I and II.

A combination seal welding and seal weld cutting machine was developed as part of the CVTR fitting and seal development effort. The function of the machine, the stress analysis of the weld lip configuration, and the acceptance testing results are discussed. (auth)

33101 (DLCS-3570110) REACTOR PLANT CONTAINER INTEGRITY TEST (AIRLOCK TEST). CORE 1, SEED 4. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First Issue, May 29, 1964. Contract [AT(11-1)-292]. 16p.

The purpose of these performances of DLCS 35701 was to prove the integrity of each of the six airlocks and to determine if mechanical seals can maintain shaft penetration leakage within an acceptable limit with the shaft handwheel operating torques at a value that operating personnel can readily supply. Mechanical seals have demonstrated that they meet the preceding requirements. Five failures of the airlock door gasket popping mechanisms occurred. Observations were made that indicate the filters in the air lines which supply the popping mechanisms were the cause of the failures. In an attempt to prevent these failures in the future, filters of a different type are to be installed during the Core 2 modification period. (auth)

33102 (EGCR-3) A DIGITAL COMPUTER PROGRAM FOR THE EGCR TEMPERATURE AND NEUTRON TRANSIENT ANALYSIS—ETNATA. Don C. Keeton (Tennessee Valley Authority, Oak Ridge, Tenn.). Nov. 18, 1963. Contract AT(40-1)-2742. 21p.

The use of a digital computer program written to solve the kinetic equations associated with the EGCR core is described. The neutron kinetic equations are solved with six groups of delayed neutrons. Temperature is calculated, based on the neutron level, the temperature feedback is used. Provisions are made to vary several operating parameters as a function of time. A scram routine is provided so that the reactor may be shut down realistically. The program will be used for control studies, design of kinetic experiments, and accident analysis. (auth)

33103 (GEAP-4567) PREOPERATIONAL POWER STABILITY ANALYSIS OF THE CONSUMERS BIG ROCK POINT PLANT. J. M. Case (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Feb. 1964. Contract AT(04-3)-361. 106p.

An analytical study of the stability of the Big Rock Point Nuclear Reactor was performed for the plant as built, and supplements a previous design study (GEAP-3795; NSA 16: 1245). The plant was determined by this analysis to be very stable under every mode of operation anticipated during Phase I of the development program testing. Even under conservative assumptions of system parameters the minimum calculated gain and phase margins do not go below 13.0 db and 46 degrees, respectively. (Nor are these both reached simultaneously for the same operating condition.) These are characteristics of a very stable, well-behaved system. In addition to this analysis, a second, less conservative series of computations was performed to provide expected realistic closed loop data for comparison with Phase I test results. The most responsive test thus predicted occurs at 60 percent power, 1500 psia, minimum flow, and maximum subcooling. For this case the closed loop peak response of power to reactivity occurs at a frequency of 0.90 cycles per second with an amplitude of 3.90 db. This corresponds to an expected open loop gain margin of 16.5 db and a phase margin of 63 degrees. Although knowledge of reactor transfer function is to be determined from tests designed around the analyzed cases, no operational cases will approach an unstable or even a substantially underdamped situation, according to the analytical predictions. (auth)

33104 (HW-73130) HANFORD GRAPHITE SUPERHEAT REACTOR (HGSR) DESIGN STUDY AND EVALUATION. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT (45-1)-1350. 224p.

The technical problems and economic potential of graphite-moderated, pressure-tube power reactors are explored for single reactors for 300- and 1000-Mw(e) plants, taking as an example a design HGSR (Hanford Graphite Superheat Reactor), employing once-through cooling in which reactor coolant is delivered to the turbine as superheated steam. Coolant enters the reactor as 400°F water and reaches the turbines as 1000°F steam at 1100 psig. The fuel elements are of compacted uranium dioxide in concentric rod and tubes, stainless steel or Incoloy clad, in a re-entrant assembly, inserted from the top of the reactor into a zirconium alloy pressure tube. Knowledge from design, procurement, and construction of N-Reactor is applied wherever practicable, especially in the moderator, shields, pressure tubes, and auxiliary systems. Technical problems are envisaged in corrosion of fuel cladding, coolant flow instability in critical boiling stages, high fuel cladding stresses, and deposition of salts on fuel element surfaces in the superheating region. If these can be solved successfully in the next 6 years or so, the reactor type would appear to have good economic potential in large sizes. For 300 Mw size, the unit capital costs are estimated to be $168/kw, and the energy costs 5.57 to 6.06 mills/kwh, depending on fuel exposure and cladding. In the 1000 Mw size, the unit costs are estimated to be $132/kw,

and the energy costs 4.42 to 4.85 mills/kwh. These costs were computed by AEC Cost Guide methods. (auth)

33105 (IDO-28626) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Quarterly Progress Report, January 1–March 31, 1964. (Aerojet-General Nucleonics, San Ramon, Calif.). May 15, 1964. Contract AT(10-1)-880. 98p.

The ML-1 power plant did not operate this quarter. The ML-1-I fuel elements were modified to correct a deficiency of the lower spider assembly. The modification and testing of the CSN-1A turbine-compressor (t-c) set was completed. The t-c set was installed on the power conversion skid and checked out in anticipation of cold rotation in April. Inspection of a tube removed from the seven-tube mock-up of the ML-1 calandria, which had operated for 4256 hr at a reference ML-1 conditions, revealed no evidence of corrosion or other deleterious effects. The calculated hot spot temperature for the ML-1-I fuel elements was revised downward from 1700 to 1650°F by a re-evaluation of hot spot factors which included considerations of recent experimental data. Evaluation of the ML-1-II burnable poison was completed. The IB-17R-2 post-irradiation examination was completed; no abnormal conditions were observed. Irradiation of the IB-17R-3 test element continued without incident. The ML-1A preliminary design was essentially completed. The design of all plant components except the t-c set was completed. The Title II design of modifications to the GCRE facility to permit testing of the ML-1 reactor skid without the power conversion equipment was completed. (auth)

33106 (NAA-SR-9718) OPERATING EXPERIENCE WITH INTERMEDIATE HEAT EXCHANGERS AT THE HALLAM NUCLEAR POWER FACILITY. R. E. Durand (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Issued June 15, 1964. Contract AT(11-1)-Gen-8. 31p. (CONF-258-4)

From the Sodium Components Development Program Information Meeting, Palo Alto, Calif., Aug. 1963.

At the Hallam Nuclear Power Facility (HNPF), heat is transferred from the reactor to the sodium-to-water steam generators by means of six heat transfer loops: three primary (radioactive) sodium loops and three secondary (nonradioactive) sodium loops. Heat is transferred from each primary loop to each secondary loop through sodium-to-sodium heat exchangers, called Intermediate Heat Exchangers (IHX's). The IHX's at HNPF exhibited tube vibration, and as a result, one of the units developed a leak between the primary and secondary side. Discovery of the leak, analysis of the cause, repair and modification, and subsequent performance of the units are discussed. (auth)

33107 (ORNL-3475) DEVELOPMENT OF FABRICATION PROCEDURES FOR CORE B FUEL ELEMENTS FOR THE ENRICO FERMI FAST BREEDER REACTOR. R. G. Donnelly, W. C. Thurber, and G. M. Slaughter (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 177p.

The element consists of fourteen 0.112-in.-thick fuel plates spaced 0.054-in. apart to form a rigid bundle 2.270-in. high × 2.386-in. wide × 20 $^{3}/_{32}$-in. long fabricated to extremely close tolerances. The attachment of a multiplicity of additional components, such as spacers, bushings, wear balls, and seal strips, was also required. A total of six dummy solid stainless steel and seven prototype elements containing depleted UO_2 was fabricated by furnace brazing. Over 100 individual parts were joined for each fuel element in a single brazing operation. The nickel–chromium–silicon brazing alloy chosen for this application met all brazing, corrosion, strength, and nuclear requirements. Special fixtures and techniques were developed for the complex and close tolerance machining work, and special procedures were developed for inspecting the various critical dimensions of the element. A detailed description of all procedures used is presented, and with one exception, it is believed that these procedures can produce fuel elements meeting the specifications. The exception is the inability to consistently maintain the coolant-channel width within 2.246 ± 0.002 in. Complete drawings are included. (auth)

33108 (RT/ING(64)-3) STUDIO DEL SISTEMA DI REGOLAZIONE A POTENZA DELL'IMPIANTO P.R.O. (Study of the Control System for P.R.O. Power Plant). G. C. Ambrosini, G. Cipollina, and A. Mathis (Italy. Comitato Nazionale per l'Energia Nucleare, Casaccia). Jan. 1964. 42p.

The control system of the P.R.O. organic nuclear reactor plant consists of several channels corresponding to the following control variables: coolant temperature at the reactor outlet; steam pressure at the turbine inlet valve; organic mass flows in the heat exchangers; and nuclear power level. The design criteria and the analytical methods followed for the synthesis of the control system are described as well as the analog study and the models and techniques used to stimulate the plant dynamics. The results and the system performance are given. (auth)

33109 (TID-20828) HALLAM NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 22, MAY 1964. R. E. Durand and I. O. Sunderman, eds. (Consumers Public Power District, Lincoln, Neb.). Contract AT(11-1)-513. 68p.

The operation and performance of the Hallam power reactor are summarized. Information is included on: core performance, sodium purity, control, testing, instrumentation, radiation control, maintenance, modifications, training programs, and power output. (N.W.R.)

33110 (EURAEC-1059) HEAT TRANSFER IMPROVEMENT IN BOILING WATER REACTORS. Quarterly Report No. 16. (Societe National d'Etude et de Construction de Moteurs d'Aviation. Division Atomique, Suresnes, France). Apr. 29, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 058-61-7 RDF. 11p. (A translation)

The thermal-hydraulic and neutronic properties of boiling reactors are studied. Tests on one- and two-phase water-air flows in channels containing twisted tapes are discussed. The influence of the surface state on the critical flux is measured on the four parallel rod test section. The influence of the vacuum rate axial variation on the determination of the infinite multiplication factor of a lattice is studied. (N.W.R.)

33111 CLEAN CONDITIONS IN THE CONSTRUCTION OF THE LOADING AND UNLOADING MACHINES FOR THE TOKAI-MURA ATOMIC POWER STATION. U. Kaun (Maschinenfabrik Augsburg-Nurnberg AG, Hamburg). Atomwirtschaft, 9: 272-6(June 1964). (In German)

The two identical loading and unloading machines for the Japanese atomic power station at Tokai-Mura were constructed. The make-up of the two 32-m high machines, each weighing 550 tons, was determined by the requirement that they be proof against earthquakes. In contrast to normal machine construction practice it was necessary to observe specially clean conditions during the manufacture of the work pieces which lie in the gas stream of the reactor. Since all components which are situated in the

reactor stream have to be nuclear clean the usual commercial parts normally supplied with an anticorrosion coating had to be supplied with a bright metal finish. To prevent corrosion all ferritic parts were coated with an iron phosphate. The cleansing provisions involved surface treatments including essentially the following: coating with nuclear compatible materials, degreasing, derusting, washing, phosphating, and assembly in a clean condition room. (auth)

33112 URANIUM SUPPLIES AND ENERGY RESERVES. M. Muysken and W. W. Nijs. Atoomenergie Haar Toepassingen, 6: 69-73(Apr. 1964). (In Dutch)

It had been expected that in Western Europe nuclear energy should become competitive with energy produced in conventional installations between 1970 and 1980. This depends on various factors, especially whether sufficient supplies of uranium would be available after 1970. Among other factors are energy consumption and the development of breeder reactors. The suggestion that the construction of thermal reactors be suppressed in favor of breeder reactors is discussed. It is concluded that the rate of progress of thermal reactors is dependent on the degree of economic competition, provided that breeder reactors are economically feasible before the year 2000. (tr-auth)

33113 THE ECONOMICAL SIZE OF NUCLEAR POWER STATIONS. [PART] II. D. Ufer. Kernenergie, 7: 281-90(May 1964). (In German)

The economies of power generation and transportation for power stations with nuclear reactors is discussed. The costs of the immovable installations involved were analyzed and the economies of power transportation are discussed. Finally, the optimum operating conditions and expenses for utilities and other miscellaneous costs are considered. (OTS)

33114 NUCLEAR POWER PLANTS. DESIGN, OPERATING EXPERIENCE AND ECONOMICS. Robert L. Loftness. Van Nostrand Nuclear Science Series. Princeton, New Jersey, D. Van Nostrand Company Inc., 1964. 560p. $12.50.

A survey is presented of specific nuclear power plants that have been built or are being built throughout the world. Prototype power reactors are included in some cases. Engineering principles, reactor fuels and materials, pressurized-water reactors, boiling-water reactors, heavy-water reactors, organic-cooled reactors, liquid-metal cooled reactors, gas-cooled graphite-moderated natural-uranium reactors, high-temperature gas-cooled reactors, fluid fuel reactors, aerospace reactors, and economics are considered. (R.E.U.)

33115 FUEL-CYCLE ECONOMICS OF LARGE, D_2O-MODERATED, ORGANIC-COOLED POWER REACTORS. R. J. Rickert (Combustion Engineering, Inc., Windsor, Conn.). 5p. (CONF-504-8)

From American Power Conference 26th Annual Meeting, Chicago, Apr. 1964.

Total fuel costs on the order of 1 mill/kwh are estimated for heavy-water-moderated, organic-cooled, pressure-tube power reactors. Total generation costs of these plants, operated on a base-load basis, are estimated at 3 to 5 mills/kwh. Advantages and disadvantages of the concept are discussed. (T.F.H.)

33116 REACTOR SITING AND ENGINEERED SAFEGUARDS FOR NUCLEAR POWER PLANTS. Theodore Stern (Westinghouse Electric Corp., Pittsburgh). 33p. (CONF-504-9)

From American Power Conference 26th Annual Meeting, Chicago, Apr. 1964.

The development of engineered safeguards for use as substitutes for isolation distance in reactor siting is discussed. Reactor containment, shielding, atmospheric dilution of radioactivity, air filtering systems inside the reactor container, and vapor containers are considered and applications of these safeguards described. (M.C.G.)

33117 PROCESS AND DEVICE FOR TEMPERATURE CONTROL OF A COOLING FLUID IN A STEAM GENERATOR. (to Fives Penhoët). French Patent 1,294,196. Apr. 16, 1962. Filed Apr. 10, 1961.

In gas-cooled nuclear reactors at lower power the steam generator may cool the reactor coolant too much. This could lead to undesirable effects. Therefore measures were taken to keep the temperature of the reactor coolant leaving the steam generator at a constant level. These measures consisted of controlling the water flow in the economizer and in controlling the inlet temperature of the evaporizer equal to the saturation temperature of cold water injection in the steam drum of the steam generator. In case of a lowering of the reactor power the fluid flow through the economizer is lowered by a given quantity, which in turn is injected into the steam drum. (IIB)

33118 NUCLEAR POWER PLANT. (to Sulzer Freres S.A.). French Patent 1,295,051. Apr. 24, 1962. Priority date Sept. 21, 1960, Switzerland.

Steam-cooled nuclear reactors are described in which the steam formed outside the reactor is superheated in the reactor core before it is divided into two portions, the first one for driving the turbine, while the second one is recooled by injection of water coming from the condenser. The recooled steam is refed to the reactor with the aid of a blower. In order to avoid blowers that are too big, this second portion of superheated steam passes as a primary fluid through a heat exchanger and thereafter through a blower, while the water coming from the condenser is fed by an ordinary feeding pump to the secondary circuit of the heat exchanger wherein it is evaporated and finally mixed with the second steam portion downstream of the blower. (IIB)

33119 OPERATING PROCESS FOR A MOTIVE POWER INSTALLATION COMPRISING A NUCLEAR REACTOR, AND DEVICE FOR PERFORMING THIS PROCESS. (to Escher Wyss S.A.). French Patent 1,307,545. Sept. 17, 1962. Priority Date Dec. 22, 1960, Switzerland.

Nuclear power installations, with a gaseous working medium flowing in a closed circuit consisting of a compressor, a nuclear reactor for heating the medium, and a turbine, in which the medium is expanded while a small amount of the gas is continuously bled off to a cleaning circuit, are considered. A method was developed by which at least a part of the cleaned gas is injected into at least one of the bearings of the turbo-machine to form a gas layer lubricating and supporting the turbo-machine axle, before it is reintroduced into the main circuit. The cleaning circuit also contains an auxiliary compressor for increasing the pressure of the gas injected into the bearings. (IIB)

33120 SAFETY DEVICE FOR NUCLEAR POWER REACTORS. (to Beteiligungs-und Patentverwaltungs GmbH and Brown, Boveri and Cie AG). French Patent 1,319,796. Jan. 21, 1963. Priority date Apr. 28, 1961, Germany.

A safety device was designed for gas-cooled power reactors provided with a gas supplying vessel, arranged outside the reactor shielding wall and adapted to supply fresh cooling gas to the reactor main vessel. The duct connecting these two vessels was designed with a delay line controlled by the difference of pressures in the vessels. In case the pressure within the supplying vessel is higher than

that within the reactor main vessel, fresh gas may flow freely into the main vessel. If the pressure in the main vessel is higher, the delay line is put into action, so that the contaminated gas coming from the main vessel flows with such a low speed through the delay line, that during the passage of the gas its activity is diminished by radioactive decay to an admissible value. (IIB)

Process Heat Reactors

33121 (A/CONF.28/P/220) NUCLEAR REACTORS APPLIED TO WATER DESALTING. James T. Ramey (Atomic Energy Commission, Washington, D. C.), James K. Carr, and Robert W. Ritzmann. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The use of nuclear energy to desalt sea water is discussed. Water shortages in the United States and around the world are reviewed. The history of desalination activities is outlined. Results of studies of the use of heat from reactors for distillation are described. Economic aspects are discussed. (M.C.G.)

33122 (A/CONF.28/P/292) THE DEVELOPMENT OF CHEMONUCLEAR PROCESSES. B. Manowitz (Brookhaven National Lab., Upton, N. Y.), M. Steinberg, J. W. Sutherland, P. Harteck, S. Dondes, and J. H. Cusack. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The research and development work at Brookhaven National Laboratory and Rensselaer Polytechnic Institute and the pilot-plant work at Aerojet General Nucleonics are outlined, along with lesser efforts at other universities and industrial laboratories. After a brief treatment of economics, the discussion turns to radiation chemistry, specifically N_2 fixation and N_2H_4 synthesis. Other sections of the summary are devoted to fission fragment source and chemonuclear fuel development, loop operations, and contamination and decontamination. 10 references. (T.R.H.)

33123 (TID-20830) PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, February 1, 1964–April 30, 1964. (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 27p.

Work was continued on the development of a process for the gasification of bituminous coal with heat from a nuclear reactor. The design, development, and testing of a fluidized-bed gasifier for the helium recycle induction-heated simulated nuclear reactor are summarized and evaluated. Work was started on a new test loop equipped to extend the range of velocities and solid-to-gas ratios and provide better measurement of the energy required to circulate gas-solid suspensions. After first studying the energy required to circulate suspensions, the system later will be used to study ways to prevent graphite deposition. A flowmeter is described for measuring the mass flow of solids in a suspension. The meter has performed satisfactorily in tests with nitrogen-graphite suspensions up to 0.86 lb/ft^3 and with coal-gas mixtures up to 25 lb/ft^3. The development of turbomachinery for the system is discussed. (N.W.R.)

33124 WHAT HYDROGEN FROM COAL COSTS [COAL GASIFICATION, STEAM-IRON PROCESS OR NUCLEAR HEAT GASIFICATION]. Sidney Katell and John H. Faber (Bureau of Mines, Morgantown, W. Va.). Hydrocarbon Process. Petrol. Refiner, 43: 143-6(Mar. 1964).

The economic feasibility of three process systems to produce hydrogen from coal was investigated. In the coal gasification process, coal, steam, and oxygen are reacted at elevated pressure to form a synthesis gas, which is then shifted to produce hydrogen. In the steam-iron process, steam is reacted with a mixture of 5% Fe and 95% FeO_2 and hydrogen is produced. The nuclear heat process involves the reaction of steam and coal utilizing nuclear heat to supply the heat of reaction. It was concluded that hydrogen can be produced by any of these methods for $0.38 per 1000 ft^3. (M.C.G.)

Propulsion and Space

Refer also to abstracts 31781 and 32508.

33125 (A/CONF.28/P/194) THE USES AND POTENTIALITIES OF RESEARCH REACTORS. Herbert Kouts (Brookhaven National Lab., Upton, N. Y.). 11p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The development of research reactors in the U.S. is discussed, with emphasis on such aspects as technical advances, trends in uses of these reactors, areas in which expansion in research activities should be expected, possible future advances in research reactor concepts, and opinions as to the future importance of research reactors. (T.F.H.)

33126 (EUR-586.d) DIE BAU- UND BETRIEBSKOSTEN EINER KERNENERGIE-ANTRIEBSANLAGE FÜR HANDELSSCHIFFE IM VERGLEICH ZU DENEN HERKÖMMLICHER HANDELSSCHIFFE UNTER VORAUSSETZUNG GLEICHER BENUTZUNG MIT DEM ZIEL GLEICHER WIRTSCHAFTLICHKEIT. (The Construction and Operating Costs of a Nuclear Propulsion Installation for Trading Vessels in Comparison with Conventional Trading Vessels Under the Assumption of Equal Use with the Goal of Equal Economy). K. Illies (Hanover (City). Technische Hochschule) and J. Legrand (Brussels. Université). 1964. 22p.

Break-even charts are given for a 60,000, 80,000, and 100,000 twd tanker on the Venezuela route and the Persian Gulf route, for a 20,000, 40,000, and 65,000 twd manufactured-goods freighter on the Magellan route and on the Panama Canal route, and for a fast freighter on the North American route and the Australian route. (J.S.R.)

33127 (GEMP-295) 630A MARITIME NUCLEAR STEAM GENERATOR. Progress Report No. 9. (General Electric Co. Advanced Technology Services, Cincinnati). June 30, 1964. Contract AT(40-1)-2847. 60p.

The status of the 630A nuclear steam generator is presented. The preliminary specifications for a photoelastic study of the reactor–shield-plug assembly to obtain stress distributions for normal steady-state pressure loading were completed. The fuel cartridge was rearranged to provide greater axial shielding and to provide a satisfactory latch design for the longer core. Detailed calculations of the most appropriate method of reinforcing the periphery of the core tube sheets were carried out. The in-pile test of the 630A shim rod was delineated and the design of the test specimen was established. An analysis of the effect of substituting Incoloy and Inconel for the present type 304 stainless steel moderator tube shows a decrease in reactivity of approximately 1.6 and 4.2% $\Delta k/k$, respectively. Detailed temperature calculations were made in the shield plug-to-pressure vessel flange and its bolting region, utilizing the stainless steel pressure vessel. Design of the reactor pressure vessel is being enlarged both radially and axially to add more water outside of the active core and reduce the fast neutron dose rate to the pressure vessel so that low-alloy or carbon steel can

be used in this component. Two development model dynamic rod actuators were assembled and are undergoing operational testing to determine shaft seal life. Results of two-tube boiler testing indicate that automatic control stability was improved at low power by utilizing steam pressure to trim feedwater flow and steam temperature to trim primary airflow rather than the reverse used previously. Stable automatic control down to 10% feedwater flow was demonstrated. The long-term creep tests of 80Ni–20Cr fuel sheet and cladding stock are continuing. Post-test analysis of in-pile test ORF-4 was completed except for burnup analysis. Detailed materials review was initiated on structural and other non-fueled components to assess potential stress corrosion and irradiation damage problems. A detailed digital computer simulation was prepared to establish system transient characteristics and to permit investigation of the resulting system pressures and temperatures from various postulated accidents. A preliminary proposal for core removal cask cooling was received for the air-to-air and air-to-moderator water heat exchangers. Correlation of methods of calculating the pressure drop of the waste-air-loop charcoal beds with the laboratory data of other researchers resulted in fair agreement. Flooding measurements in the 630A critical experiment reactor show a shutdown margin with the reactor scrammed and flooded of 7% Δk/k. This should allow shutdown to be maintained even without being able to use the rods ganged on the two actuators having the highest worth. Worth of the borated-steel burnable poison was re-evaluated in the critical experiment using sub-critical rod shape curves. It was found to be about 12% Δk/k when the boron was distributed over the full 27.5-inch core length and approximately 13% Δk/k when distributed uniformly over the lower 22 inches of the core. Feasibility surveys and cost estimates were made for locating the test facility in either the 607 TAN building or adjacent to the 615 TAN building at NRTS. (auth)

33128 (NAA-SR-9525(Vol.I)) BIBLIOGRAPHICAL SURVEY OF SNAP FUEL MATERIALS. VOLUME I. ZIRCONIUM–URANIUM HYDRIDE AND RELATED ZIRCONIUM AND URANIUM SYSTEMS. A. W. Barsell, L. D. Montgomery, and J. T. Roberts (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT-11-1-GEN-8. 220p.

A two-volume bibliographical survey of SNAP fuel materials, reviewing all investigations conducted on zirconium-uranium-hydrogen systems is presented. This survey was compiled under the direction of the Atomics International SNAP Aerospace Safety Program. Recent unclassified publications on the individual metals, alloys, oxides, and hydrides are included. Emphasis was placed upon experimental, quantitative data resulting from the investigations in their respective temperature and composition ranges. Also, particular interest was given to thermodynamic property data obtained in these related studies, and these data are subject-indexed for each material with the respective temperature ranges. Abstract data may be found through author's name, subject matter, or report number indexes common to and appearing in each volume. Volume II consists of abstracts of classified publications concerning zirconium hydride and zirconium-uranium hydride. (auth)

33129 (NP-14062) PARAMETER STUDIES OF NUCLEAR ROCKET VEHICLES. R. Garcia, F. G. Hammitt, and J. F. Rice (Michigan. Univ., Ann Arbor). Mar. 15, 1963. 75p.

A computer-programmed parameter study of two specific nuclear space-power systems, one suitable as a propulsion unit and the other for auxiliary power applications, was undertaken for IBM 7090. The first program is concerned with an overall vehicle design with particular attention being given to the thrust-burnout velocity relation. It is shown that a reactor producing a thrust of 1,000,000 lbf can result in a burnout velocity of 30,000 feet/sec, ample for many space missions. The second program examines in detail the design of the nuclear reactor core. An iteration on the mass flow rate results in a value compatible with the specified maximum allowable material temperature. The effects of variation of core length, coolant outlet temperature, thrust, coolant channel diameter, and channel spacing are investigated. Values for a typical core would be a diameter of 4 feet, a length of 5 feet, a coolant outlet temperature of 4000°F, a coolant channel diameter of 0.25 inches, a channel spacing of 0.50 inches, a thrust of 100,000 lbf, and a core weight of 5000 pounds. Many plots are presented so that several designs are possible depending on individual requirements. The third program (not yet completed) will be concerned with the design of a SNAP reactor system for auxiliary power. A reactor heat source utilizing a Rankine heat cycle or gas turbine cycle and employing a liquid metal such as sodium for the coolant is considered. The effort will consist of determining the weights of the various system components as a function of the radiator temperature. The program would iterate on the radiator temperature over a wide range of values. The optimum system would then be taken as the one with minimum reactor weight. (auth)

33130 (SC-DC-64-1061) DISPERSAL OF REACTOR CORE MATERIALS BY REENTRY PROCESSES. Quarterly Report. Report No. I10-100-3. J. L. Beal, W. R. Brown, and F. A. Vassallo (Cornell Aeronautical Lab., Inc., Buffalo). Apr. 1964. For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 35p.

An interpretation of the data on the explosions which are observed to occur when small drops of zirconium are allowed to fall through air is presented. The interpretation permits optimism about the disintegration of any drops which separate from a rod which is being heated and melted during its deceleration while reentering the earth's atmosphere. The explosion process is observed to lead to fine smoke particles and to tiny thin-walled hollow spheres which have slow settling rates. The problem of melting the rods completely during their deceleration is discussed. To supplement other studies in this area, a bench test apparatus is assembled which permits observations of melting and ablation of small rods, or wires, and permits the collection of the resulting debris. This utilizes an arc jet as the source of hot gas. The apparatus and the initial trial tests are described. (N.W.R.)

33131 (TODD/SML-NSS-6) N.S. SAVANNAH OPERATIONS, MAY 1962 THROUGH MARCH 1963. (Todd Shipyards Corp., Galveston, Tex. and States Marine Lines, Inc., Yorktown, Va.). Mar. 15, 1963. 141p.

A summary is presented of the overall performance of the reactor plant and ship for the period May 1, 1962 to March 1, 1963. Also discussed are manning, organization of a shoreside engineering and support group, servicing and maintenance facilities, and administrative features. The report supplements and replaces TODD/SML NSS-3, which covered the period May 1, 1962 to Nov. 1, 1962. (R.E.U.)

33132 A SPACE POWER CONVERSION SYSTEM UTILIZING THE BRAYTON CYCLE AND A DIRECT COUPLED NUCLEAR REACTOR. H. J. Snyder, Jr. (Aerojet-General Corp., San Ramon, Calif.), James Munier, and James E. McCormick. New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-454, 25p. $1.00. (CONF-600-10)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

The results of a design study of a 100 kw space power system combining a gas-cooled reactor heat source coupled directly to a closed-recuperated-Brayton cycle power conversion system are presented. The working fluid is used as both the heat source coolant and the bearing lubricant. Power cycle design considerations, reference system design, reactor analysis and design, and system control are discussed. (C.E.S.)

33133 NUCLEAR PROPULSION IN MANNED AEROSPACE SYSTEMS. J. T. Celentano, D. Amorelli, G. D. Kohler, B. B. Adams, and P. G. Peters (North American Aviation, Inc., Downey, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-387, 8p. $1.00. (CONF-600-13)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

A brief review of the concepts for manned space flight by means of the single-stage nuclear reactor-powered space ship is presented. Nuclear propulsion and power systems, radiation doses, safety problems, operations, and hazards analysis are discussed. (C.E.S.)

33134 CONCEPTUAL STUDY OF A LIQUID-CORE NUCLEAR ROCKET. Seymour T. Nelson, Jerry Grey, and Peter M. Williams (Princeton Univ., N. J.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-385, 15p. $1.00. (CONF-600-14)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

In the liquid-core reactor concept, the temperature limitation of solid reactors is relaxed by utilizing liquid-phase fissionable fuel in the highest-temperature portions of the reactor. Such a reactor is composed of a number of cylindrical fuel elements, each consisting of an outer region of solid fuel-moderator mixture and an inner layer of the same mixture, but in the molten phase. Containment of the liquid within the core is achieved by rotation of the fuel elements, and the propellant gas is introduced radially inward through perforations in the fuel elements, bubbling through the hot, molten-fuel annuli and exhausting axially to a nozzle. The performance potential and feasibility of this concept is examined, through a number of simplifying but conservative assumptions, in the closely interrelated areas of nucleonics, heat transfer, bubble hydrodynamics, and vapor entrainment. A brief description of a current experimental program designed to evaluate certain of the basic assumptions is also presented. It is concluded that the multi-element liquid-core nuclear rocket appears to be feasible, providing specific impulse values upwards of 1200 seconds at thrust/weight ratios of the order of unity, with far more practicable design requirements than were indicated by the single-element configurations of other investigators. (auth)

33135 A CLOSE APPROACH SOLAR PROBE DESIGN FEASIBILITY AND MISSION STUDY. J. G. Lundholm, Jr., E. S. Prohaska, S. Hoyer, and J. Averell (Avco Corp., Wilmington, Mass.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-496, 19p. $1.00. (CONF-600-25)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

A brief description of the launch vehicle, trajectory, propulsion, the spacecraft, the orbiter, materials, power supply, communications, altitude control, and thermal control of a solar probe is given. (C.E.S.)

33136 DESIGN OF A MULTIPLE-UNIT SNAP 2 POWER SUPPLY FOR A MANNED SPACE STATION. William V. Botts (North American Aviation, Inc., Canoga Park, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-458, 20p. $1.00. (CONF-600-4)

From American Institute of Aeronautics and Astronautics 1st Annual Meeting, Washington, D. C., June-July 1964.

The design characteristics of multiple-unit SNAP 2 systems for the power range of 5 to 40 kw are discussed. These systems are based on the concept of using a single reactor heat source, either the SNAP 2 or SNAP 8 reactor, supplying power for the multiple SNAP 2 mercury Rankine power conversion systems to produce the total power required. The reliability, shielding, safety, and overall system design are outlined. (C.E.S.)

Research and Test Reactors

33137 (A/CONF.28/P/221) THE OAK RIDGE HIGH FLUX ISOTOPE REACTOR. John A. Swartout (Oak Ridge National Lab., Tenn.), A. L. Boch, T. E. Cole, R. D. Cheverton, G. M. Adamson, and C. E. Winters. 17p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A complete description of HFIR is given including fuel, reflector, control systems, heat transfer and corrosion aspects, targets, and associated experimental facilities. (R.E.U.)

33138 (A/CONF.28/P/222) THE BROOKHAVEN HIGH FLUX BEAM RESEARCH REACTOR. J. M. Hendrie (Brookhaven National Lab., Upton, N. Y.). 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A complete description of the HFBR and its associated experimental facilities is given. (R.E.U.)

33139 (A/CONF.28/P/223) THE NRTS ADVANCED TEST REACTOR. D. R. deBoisblanc (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho), R. H. Gordon, A. H. Lazar, and L. J. Weber. 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

The Advanced Test Reactor at the National Reactor Testing Station near Idaho Falls, Idaho, is described. Under optimum conditions and at design power of 250 Mw unperturbed thermal fluxes of 2.5×10^{15} nv are achieved. It can be operated so that both spectrum and flux levels can be adjusted independently for five loops and maintained nearly constant for a 17-day cycle. A summary of design characteristics, experimental facilities, physics, research and development, and costs is presented. (T.R.H.)

33140 (AEET/ROD/11) REACTOR PHYSICS. N. Veeraraghavan (India. Atomic Energy Establishment, Trombay). 1963. 20p. (CONF-523-3)

From IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963.

Control, flux measurements, chemical control, power measurements, and shielding for Apsara, Canada-India Reactor, and Zerlina are discussed. (R.E.U.)

33141 (IDO-16918) THE EFFECTS OF PRESSURE AND FLOW ON ROOM TEMPERATURE POWER EXCURSIONS IN SPERT III. C. R. Toole (Phillips Petroleum Co.

Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 42p.

The effects of pressure and forced coolant flow on the reactor response to step insertions of reactivity in the Spert III facility are summarized. Every power excursion, covering a period range from 500 to 10 msec, corresponding to step insertions of reactivity from 88 to 125¢ was self-limiting regardless of initial system pressure or flow rate. Several significant points were observed during the investigation of the effect of initial system pressure. Perhaps the most important of these is the fact that it is possible to suppress boiling up to the time of peak power without significantly increasing the maximum power even for periods as short as 10 msec. This indicates that the reactivity normally compensated by the formation of steam can be compensated by other mechanisms with little change in power-burst behavior. The energy release to time of peak power increases only about a factor of two when the subcooling is increased from 80°C at atmospheric pressure to 320°C at 2500 psi. The fuel-plate surface temperature also increased with increasing system pressure. The results of using forced coolant flow to suppress boiling were somewhat different than those observed in the pressure effect series. For long-period tests, since the fuel plate surface temperatures were reduced by the increased rate of heat transfer to the water and, since the hot water was then swept from the core, the reactivity compensation contribution due to water and fuel-plate expansion was reduced. In this long-period region where the energy generation rate is sufficiently slow, enough energy was removed from the core region to eliminate the initial power peak that had been observed in the no-flow tests. Instead of peaking, the power continued to rise until it reached a high enough level that the available flow was unable to remove sufficient energy from the core region, at which time the exponential power rise was terminated and the power sought an equilibrium level. For tests with initial asymptotic periods shorter than about 50 msec, the energy generation rate is increasing so rapidly that the heat cannot be removed from the core region at a rate sufficient to affect the initial power peak. Under these conditions, the initial burst is essentially the same as in the no-flow case. However, following the peak, the power again seeks an equilibrium level which is approximately proportional to the flow rate. In some cases the equilibrium level is higher than the initial power peak. The power rise during a 10-msec period transient does not deviate from an exponential until the power level is within one decade of peak power. Since the water moves only about 5 in., out of a total 36-in. core length, during this decade of power rise at the maximum available flow rate, it is reasonable that the flow rate has no significant effect on the initial power burst for short-period tests. The effect of flow rate on the power behavior is essentially the same with an initial system pressure of 2500 psi as it is with atmospheric pressure. However, increasing the flow rate tends to reduce the higher fuel plate temperature observed as the initial system pressure is increased. In some cases, the flow reduces the plate temperature more than the higher pressure increases it. (auth)

33142 (IDO-16974) SELF-LIMITING EXCURSION TESTS OF A HIGHLY ENRICHED PLATE-TYPE D_2O-MODERATED REACTOR. PART II. EFFECT OF SYSTEM PRESSURE. R. L. Johnson and J. E. Grund (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 1964. Contract AT(10-1)-205. 58p.

Self-limiting power excursion tests were conducted to investigate the effects of initial system pressure on the dynamic response of the Spert II BD-22/24 Expanded D_2O Core. This D_2O-moderated core is comprised of 3-inch square x 24-inch long, highly enriched, uranium–aluminum, plate-type fuel assemblies spaced on 6-inch centers. The power excursions were initiated by stepwise reactivity insertions at ambient temperature, with no forced coolant flow, at various initial system pressures from atmospheric to 375 psig, and both with and without an expansion space in the reactor vessel. The reactivity insertions ranged from about 50 cents to 2.6 dollars and resulted in initial asymptotic reactor periods ranging from about 5 sec to 60 msec, respectively. These tests demonstrated that the delay or suppression of boiling brought about by an increase in the system pressure results in higher maximum powers, energy releases, and fuel plate temperatures for those short period tests in which steam formation is an important contributor to shutdown at atmospheric pressure. Limited fuel plate damage occurred for tests with initial periods of approximately 70 msec or less, independent of system pressure. Calculation of the reactivity compensated by known nonboiling mechanisms gave results that were insufficient to account for the experimentally determined compensated reactivity. (auth)

33143 (IDO-24457) STUDY S-R-127—ANALOG STUDY OF THE ADVANCED TEST REACTOR PRIMARY PRESSURE CONTROL SYSTEM. L. J. Stanek (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Apr. 1963. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 19p.

An analog computer was used to investigate the performance of the Advanced Test Reactor Primary Pressure Control System. This investigation is a re-evaluation of the system analyzed in the Closed Loop Report (S-R-118). The response of the system to various controller proportional band and reset rate settings was determined. The transients were analyzed for various degassing rates. Recommended settings based on this optimization study are 2.5% proportional band and 0.33 repeats per minute reset rate. The degassing flow rate ranges from 100 to 600 gpm for zero power and from 275 to 600 gpm for full power operation. (auth)

33144 (IDO-24462) ADVANCED TEST REACTOR SERVO REGULATOR ROD TEST PROGRAM. R. T. Pickett, III (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Feb. 1964. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 59p. (ATR-IC-100)

The Advanced Test Reactor Servo Regulator Rod Test Program was performed for these reasons: 1. To verify rod mechanism characteristics reported by the United Shoe Machinery Corporation. 2. To demonstrate that rod mechanism characteristics were compatible with reactor kinetics and that overall reactor system behavior was stable. 3. To recommend system modifications needed for satisfactory performance. The overall system response was good. Except for the addition of a position feedback potentiometer, the rod drive system required no mechanical modification. Since specific lead-lag network components and controller gains can now be given for initial setup at the site, field adjustment for desired plant performance can begin. (auth)

33145 (IDO-24463) ADVANCED TEST REACTOR FUEL ELEMENT HYDRAULIC BUCKLING TESTS. H. D. Ferris (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.) and J. C. Moyers (Oak Ridge National Lab., Tenn.). Oct. 1963. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 131p. (ATR-FE-100)

The hydraulic buckling tests on the fuel elements in the Advanced Test Reactor (ATR) were performed to determine whether the water channels in the element would collapse or fail under reactor operating conditions of temperature, coolant velocity, and differential pressure. This type of failure was experienced in the MTR and ETR. Water-channel failure was also investigated analytically by D. R. Miller, but the uncertainties arising necessitated a test program. The ATR Mark IV fuel element forms a 45-degree segment of an annulus. The element is made up of 19 fueled plates curved around a common center and two side plates inclined at an angle of 45 degrees to one another. All of the fuel plates contain a 0.020-inch thickness of centrally located fuel. The innermost plate (nearest the common center) and the outermost plate are 0.080 and 0.100 inches thick, respectively; all other fuel plates are 0.050 inch thick. The original clad material (8001 aluminum alloy) was replaced with 6061-0 aluminum which has superior strength. The 6061-T6 aluminum side plates are nominally 0.188 inch thick. The fuel plates are joined to the side plates by a roll-swaging process, and the nominal water channel is 0.078 inch. Owing to the curvature, the channels and the fuel plates vary in peripheral width from 2.2 to 4.0 inches. The fuel plates are slightly over 4 feet long, and the nominal flow velocity is 46 fps. The vertical pressure drop across the core is 100 psi. For this test program, the elements were placed in a holder that duplicated the water channels exterior to the fuel element. In the reactor, the outer channel is formed by either the beryllium reflector or the neck shim housing; the inner channel is formed by the flux trap baffles, and the side channels are formed by the adjacent fuel elements. The physical geometry of this arrangement was duplicated as nearly as possible by a holder mounted in a pressure pipe in a hydraulic loop. Due to the fabrication tolerances, the outer channel (No. 20) can vary in size and in shape. Hydraulic calculations indicated that a tapered channel, which can exist due to these tolerances, would produce the maximum lateral pressure differentials across the two exterior plates (No. 1 and No. 19). Although Miller's work only investigated local channel deviations, it was felt that these stable lateral pressure differentials might also contribute to collapse or gross failure. The tests were performed with a variety of Channel 20 shapes, all of which could exist in the reactor due to the tolerance situation. In the reactor, the fuel plates will have maximum temperatures in the range of from 400 to 500°F. The side plates will operate in the 250°F range. Since the purpose of the tests is primarily to determine fuel plate performance and since the fuel plate stresses decrease towards the side plates, the tests were performed at a temperature of 420°F. It was felt that this temperature would best represent, for structural test purposes, the operating temperature distribution. Several specimens using a variety of Channel 20 configurations were tested at varying flow rates up to a maximum vertical pressure drop of 145 psi and at a velocity of 77 fps in Channel 19. Except for the first Mark III specimen tested, no gross failures or fuel plate collapse occurred. The lateral differentials created by the Channel 20 configuration did produce serious permanent deformations of the fuel plates. Measurement of the elastic or operating test deflections could not be performed, but from the magnitude of the permanent distortions it was believed that the operating test deflections had been large. In the last test specimen, the element was ventilated with holes through the side plates to reduce the pressure differentials. The pressure differentials and permanent distortions were reduced to an acceptable level by this design change, and no gross restriction or failure of coolant channel occurred. A modification of this ventilated design is the present reference design fuel element. The hydraulic buckling tests are tabulated. The hydraulic data and permanent plate distortions are described in detail. (auth)

33146 (IDO-24465) ADVANCED TEST REACTOR BURNOUT HEAT TRANSFER TESTS. M. W. Croft (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Jan. 1964. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 60p. (ATR-FE-102).

Burnout tests were conducted to determine the limiting heat flux in a simulated ATR fuel element channel. Burnout was approached holding all variables constant except one. Power, pressure, flow, and inlet temperature were all varied to approach burnout in different tests. Channel exit pressures were varied from 80 to 250 psia, mass velocities from 5.5×10^6 to 12.5×10^6 lb/hr-ft^2, and inlet temperatures from 120 to 240°F. Maximum heat flux at burnout varied from 0.95×10^6 to 3.88×10^6 Btu/hr-ft^2. Burnout in the 0.054- and 0.072-inch channels was due to hydraulic instability or autocatalytic vapor binding when the coolant reached saturation at the exit of the channel. Burnout in the 0.094-inch channel occurred at a power level less than that required to produce saturation at the exit in most of the tests. The burnout heat flux in this channel was about 60% of the burnout flux predicted by Bernath's equations. (auth)

33147 (IDO-24466) ADVANCED TEST REACTOR FUEL ELEMENT HYDRAULIC TEST PROGRAM. M. A. Slominski (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.); and R. J. Kedl (Oak Ridge National Lab., Tenn.). Mar. 1964. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 279p. (ATR-FE-103)

A fuel element hydraulic test program was conducted at Oak Ridge National Laboratory to study hydraulic characteristics and provide design information for the fuel element. The program verified that dissimilarities of internal and external channels produced excessive lateral pressure differentials in the initial element. A variety of modifications, including end box redesign, improved interconnection around the element, and a sideplate slotting scheme, was added to the element design, and the resulting hydraulic characteristics were determined. This modification process continued until lateral pressure differentials were reduced to levels that ensure the mechanical-structural integrity of the modified element at operating reactor flow rates. Results from tests on the final Mark IV element showed that pressure differentials across the outer fuel plates can be limited to about 5 psi under the most extreme external channel geometry variations if fluid interconnection is maintained around the element through the nominal 0.072-inch sideplate channels. The program also included a series of flow distribution tests to determine flow and hydraulic characteristics in a scaled-up channel and in an entire element; these tests verified thermal and hydraulic design factors that were used in the reactor performance and hazards evaluations. The flow distribution tests on the full-scale element required many piezometer taps, which penetrated through the sideplate channels and the fuel element sideplates. Since these taps interfered with interconnection around the element, the test results differed from actual operating conditions for the most severely tapered external channel. Results from the investigation of flow distribution characteristics in the scaled-up channel indicated that velocity decreased rapidly near the sideplates in isolated portions

of the channels. However, since critical thermal areas are several channel thicknesses from the sideplates, the velocity profile at these hot tracks was only slightly less than the average channel velocity. Similarly, velocity profiles were adversely affected near slot zones when coolant flowed from internal to external channels. The worst profile was at the lower edge of the slot, but the velocity deviated from the average channel velocity less than the 6% value used in the thermal calculations. (auth)

33148 (IFA-FN-23) SEPARATION OF THE COLD NEUTRONS FROM THE SPECTRUM OF HORIZONTAL BEAMS OF A V.V.R.S. REACTOR. D. Bally, M. Popovici, B. Grabcev, and M. Popescu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1964. 17p.

The use of neutron mirrors to eliminate neutrons above "cold" energies is discussed. The optical properties of a system of two Soller collimators formed by four copper-coated glass mirrors were studied. The spectral distribution of the transmitted neutron beam was determined, and the luminosity of the experimental arrangement was estimated as a function of its geometry and of the quality of the collimator wall surfaces. (R.E.U.)

33149 (ORNL-TM-745) CONSIDERATIONS INVOLVED IN THE SAFETY REVIEW OF EXPERIMENTS TO BE OPERATED IN NUCLEAR REACTORS. C. D. Cagle (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 89p.

Basically same report as RCN-Int-64-010.

The reasons for safety and operability reviews of experiments are discussed along with the qualifications of reviewers and the methods of reviewing. Examples of the questions that must be answered in reviewing noninstrumented and instrumented capsules, loops, and beam experiments are included with some comments pertinent to the questions. (auth)

33150 (SC-RR-64-524A) SANDIA ENGINEERING REACTOR REACTIVITY MEASUREMENTS. C. A. Anderson, Jr. (Sandia Corp., Albuquerque, N. Mex.). June 1964. Contract [AT(29-1)-789]. 53p.

Measurements of the equivalent reactivity worth due to control elements, fuel, materials, voids, and temperature are reported for the Sandia Engineering Reactor. (auth)

33151 (ANL-Trans-44) USE OF THE HEAVY WATER REACTOR OF THE INSTITUTE OF THEORETICAL AND EXPERIMENTAL PHYSICS OF THE ACADEMY OF SCIENCES SSSR FOR CONDUCTING PHYSICAL EXPERIMENTS. P. A. Krupchitskii. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Institute of Theoretical and Experimental Physics, No. 121, Moscow. 1963. 29p.

The report deals with the state of research work that has been carried out on the heavy water reactor with consideration of the organization and the planning of experiments. Particular emphasis is placed on the setup of the following experiments: the measurement of the electron-neutrino correlation at the decay of a free neutron, measurement of resonance neutron cross sections by means of a neutron selector with a mechanical chopper, formation of beams of polarized thermal neutrons and spin measurements of compound nuclei and magnetic momenta of short-lived nuclei, studies of spectra of γ-rays emitted at the neutron capture by nuclei, critical experiments on the heavy water reactor, thermal-neutron density distribution in fuel elements, experimental setup for the refinement of the spatial invariance of nuclear energy, and experiments on the physics of solids. 62 references. (auth)

33152 (CEA-R-2458) RECHERCHE D'UNE POLITIQUE DE GESTION DU COMBUSTIBLE D'UNE PILE PISCINE. (Determining a Pool-Type Reactor Fuel Policy). (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). May 1964. 43p.

Partly translated into English.

Refueling of the 10- to 15-Mw pool-type reactor considered will occur frequently (some 10 elements every 3 to 4 weeks). It is therefore necessary to determine the most economic fuel policy. The study proposes to define a strategy that will make it possible to decide on the number and characteristics of the shipment containers, as well as on the means of storage, so as to reduce the risks as much as possible should the basic parameters of the study vary. Among these parameters, the respective influence of which is investigated, chemical reprocessing costs play a vital part. Two examples of optimum fuel management are given according to whether the reprocessing charges applied are those of the old or of the 1961 USAEC base charges for reprocessing highly enriched irradiated fuel. (auth)

33153 γ-RADIATION FROM THE IRT-2000 REACTOR OF THE BELORUSSIAN ACADEMY OF SCIENCES. A. P. Bogdanov and E. I. Firsov. At. Energ. (USSR), 16: 354-5 (Apr. 1964). (In Russian)

The spectrum of the γ-radiation emitted by the IRT-2000 reactor was measured at its horizontal radial beamhole, using Pb collimators and a 20-cm thick plug containing paraffin and B carbide for filtering out the neutron beam. The measurements were carried out at a reactor power level of 50 kw, using a NaI(Tl) counter and a photomultiplier, together with a multichannel pulse-height analyzer; the spectrum was analyzed on the basis of the capture γ-radiation of Cl. The results agreed with the measurements carried out with a Compton spectrometer by L. V. Groshev and A. M. Demidov (Atomnaya Energ., 7: 257(1959); NSA 14: 2167). The chief characteristic of the spectrum was the presence of γ-radiation up to the 9-Mev level. Tests were also made with the reactor shut down after an extended operation at 1000 kw, taking the measurements during the period ranging from 30 minutes to 3 days after the shutdown. The spectrum was found to contain 0.9-, 1.15-, 1.40-, 1.85-, and 2.45-Mev γ-lines. The extinction period of the γ-radiation intensity during this period was about 3 hours; that of the 2.45-Mev line was about 10 hours. Tests made 70 hours after shutdown revealed the existence of 0.55-, 0.75-, 1.60-, 2.0- and 2.5-Mev lines; the extinction of the soft portion ranged from 3 to 4 days. The lines could not be assigned to specific isotopes because of the complexity of the spectra and the lack of precision in the behalf-life determinations. (TTT)

33154 NEUTRON DIFFRACTION IN THE HIGH FLUX REACTOR. B. O. Loopstra. Atoomenergie Haar Toepassingen, 6: 74-80(Apr. 1964). (In Dutch)

New areas in which neutron diffraction can be used are briefly reviewed. The way in which structural data can be obtained with neutron diffraction is illustrated. (tr-auth)

33155 AN OUTLINE OF THE KYOTO UNIVERSITY'S RESEARCH REACTOR, THE KUR. Kiyomi Kiryu and Kiyoshi Miyazawa (Hitachi, Ltd., Japan). Hitachi Hyoron, 45: 1411-15(Sept. 1963). (In Japanese)

The KUR is a 1-Mw research and production reactor fueled with 90% enriched uranium, moderated and cooled by light water. The reactor is of the well type, a hybrid of the swimming-pool and tank types. The core is submerged in water in the core tank, which is surrounded by a con-

crete shield. The water above the core serves as a shield and an additional concrete shield is installed on top of the tank. On the top shield are installed the control-rod drives. The fuel plate consists of an alloy of uranium and aluminum sheathed in aluminum plates. The cooling of the reactor is either by natural or forced circulation. One regulating rod and four shim-safety rods are used, the former being aluminum-clad stainless steel and the latter aluminum-clad stainless steel containing 1.5% boron. Two fission counters monitor reactor start-up and four ion chambers are used during operation. Two thermal columns, of which one is filled with graphite and the other with heavy water, and nine experimental holes of different diameters are provided. Irradiation holes, three pneumatic tubes, and one hydraulic tube are also furnished. The reactor is expected to go critical in 1964. (NSA of Japan)

33156 IN-PILE IRRADIATION OF MATERIALS HIGHLY ABSORBING NEUTRONS. W. Suckow (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 310-17(May 1964). (In German)

The effects of reactor irradiation of substances with high absorption cross sections were investigated. The high absorbing ability of these substances for thermal neutrons cause disturbances in the irradiation process and cause errors in the estimation of attainable activity, and also in that of the adjacent targets. The phenomena involved were considered theoretically and verified in the tests involving the experimental reactor in Rossendorf bei Dresden. Desirable conditions under which irradiation of strong neutron-absorbers should be undertaken are described. (OTS)

33157 THE LOCALIZATION OF DEFECTIVE FUEL ASSEMBLIES IN THE VVR-S-REACTOR. R. Kische (Institut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 345(May 1964). (In German)

Fission-gas eruptions were observed in the WWR-S reactor RFR-1 in Rossendorf from the fuel elements for the first time since the reactor was started up 5.5 years ago. The eruptions were verified with the aid of an electrostatic precipitator. Since it was not economically feasible to locate the defective elements by direct means, an indirect procedure was employed that is briefly described. Thus far, five defective elements were identified. To assist in locating defective elements in the future, development was initiated for a global defect locator. (OTS)

33158 DEDICATION OF THE FIRST ATOMIC REACTOR IN FINLAND. E. Tommila. Suomen Kemistilehti, A35(10), 170-3(1962). (In Finnish)

The FiR 1 TRIGA Mark II reactor is described. The fuel is 20% enriched ^{235}U(2.28 kg) and its effective power is 100 kw. (M.C.G.)

33159 NUCLEAR REACTOR EQUIPMENT. Leopold A. Steinert, Robert H. Dempsey, and Philip M. Clark (to General Electric Co.). U. S. Patent 3,141,828. July 21, 1964. Filed Nov. 26, 1958.

A description is given of improved pool type nuclear reactor equipment having conveniently accessible neutron flux regions and operable over a wide range of power levels with minimum radioactive contamination of the pool and minimum neutron loss. A hollow tubular structure, partially enclosing the reactor core and extending upward to the pool surface where access is permitted by a sealable door, is described. A baffle assembly, gas vents, a coolant circulating system with a header gate, and a drain are connected with this tubular structure. A movable bridge extends across the top of the pool. The coolant flow by means of this apparatus is discussed. (M.J.T.)

WASTE DISPOSAL AND PROCESSING

33160 (A/CONF.28/P/287) NORTH AMERICAN EXPERIENCE IN THE RELEASE OF LOW-LEVEL WASTE TO RIVERS AND LAKES. Herbert M. Parker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), R. F. Foster, I. L. Ophel, F. L. Parker, and W. C. Reinig. 15p. (HW-SA-3421)

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Experience in liquid-waste disposal is reported at the large atomic energy sites at Chalk River, Hanford, Oak Ridge, and Savannah River. Nuclear power plants are also considered. The fate of the radionuclides in the environment was studied, and it was determined that the total dose to the public from multiple environmental sources is well within limits. (D.L.C.)

33161 (A/CONF.28/P/868) ADVANCES IN RADIOACTIVE WASTE MANAGEMENT TECHNOLOGY—ITS EFFECT ON THE FUTURE U.S. NUCLEAR POWER INDUSTRY. W. G. Belter (Atomic Energy Commission, Washington, D. C.). 18p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

A discussion is presented on the advances in treatment and disposal of low- and high-level wastes, and their probable effects on the future nuclear power industry. Ion exchange and foam separation techniques are being applied to low-level wastes on an engineering pilot plant scale. The disposal of intermediate-level wastes into shale by hydraulic fracturing is being investigated. Calcination and fixation of high-level wastes are discussed. The feasibility of storing high-level wastes in salt mines and bedrock caverns is being studied. Engineering evaluation studies relative to the nuclear power economy in the future, indicate waste treatment and ultimate storage costs of ~0.03 mill/kwh, less than 1% of the cost of nuclear power in a 4 mill/kwh economy. (D.L.C.)

33162 (A/CONF.28/P/869) U.S. OPERATIONAL EXPERIENCE IN RADIOACTIVE WASTE MANAGEMENT (1958-1963). W. G. Belter (Atomic Energy Commission, Washington, D. C.). 16p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Highlights of U.S. waste management experience in the past six years are summarized. The experiences include those of research laboratories, nuclear production facilities, and nuclear power plants. Among the methods of waste disposal discussed are tank storage, land burial, and sea disposal. The costs of radioactive waste management are described. (D.L.C.)

33163 (BNL-832) CONTINUOUS CALCINATION OF HIGH LEVEL RADIOACTIVE WASTES BY MEANS OF A ROTARY BALL KILN. Roy F. Domish and L. P. Hatch (Brookhaven National Lab., Upton, N. Y.). Nov. 1963. Contract AT-30-2-GEN-16. 31p.

Continuous calcination of simulated, high salt content, high level radioactive wastes by means of a rotary ball kiln was demonstrated on a practical scale. The development of process equipment for operation with highly corrosive and dust-laden off-gases, with emphasis on the design features of a special rotary seal, was a central objective. Through condensation of off-gases and exclusion of air from the system, a high degree of control over dust produced in the calcination process was readily achieved. Results are presented of extensive corrosion studies required for the selection of materials of construction for equipment suitable for service in the calcination of wastes containing both fluorides and nitrates. The investigation culminated in the construction of a pilot-scale plant and was terminated after a one-month continuous operation of the plant. (auth)

33164 (CONF-179-5) REMOVAL OF RADIOISOTOPES FROM SOLUTION BY EARTH MATERIALS FROM EASTERN IDAHO. M. W. Wilding and D. W. Rhodes (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). [196?]. Contract AT(10-1)-205. 12p.

From American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964.

Naturally occurring earth materials from Idaho, primarily from localities near the National Reactor Testing Station (NRTS), were used in laboratory tests for the removal of radioisotopes from aqueous solutions. These earth materials included lignitic deposits, clay-like materials, and specific minerals; ion exchange resins were also considered for a specific application. The aqueous solutions were low-level radioactive cooling water or synthetic solutions made up to represent low-level radioactive wastes at the NRTS. Cation exchange capacities and other properties which affect the removal of radioisotopes from solution were determined. The cation exchange capacities varied from 0.006 to 1.0 meq/g of solid. Earth materials with cation exchange capacities greater than 0.3 meq/g, in general, had distribution coefficients in excess of 1000. The highest distribution coefficients for cesium and strontium occurred in the pH range from 6.0 to 9.0. The possible use of these materials for decontaminating low-level radioactive waste at the NRTS is discussed. The result of laboratory studies using these materials and an organic ion exchange resin for decontaminating a specific NRTS waste are given. A material high in clinoptilolite from a location near the NRTS was considered to be the most promising material for use in large beds or ion exchange-type columns. (auth)

33165 (ERI-6) RESULTS OF PRELIMINARY SURVEY AND MONITORING OF THE FIRST FIELD TEST OF THE DISPOSAL OF FISSION PRODUCTS INCORPORATED INTO GLASS. W. F. Merritt and I. L. Ophel (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1960. Reprinted Mar. 1964. 18p. (AECL-1918)

Twenty-five glass blocks containing about three hundred curies of aged mixed fission products have been buried in a selected area of the Chalk River disposal area. Before the burial, the direction and velocity of ground water movement were measured using tritiated water, sulphur-35, and fluorescein dye as tracers. After the burial the ground water was monitored to detect leaching of fission products and soil samples have been obtained from the vicinity of the blocks. To date, no radionuclides attributable to leaching of the blocks have been detected in the ground water. A small quantity of strontium-90 has been found in some of the soil samples. (auth)

33166 (HW-81481) WASTE MANAGEMENT PROGRAM—CHEMICAL PROCESSING DEPARTMENT. S. J. Beard, R. J. Kofoed, J. J. Shefcik, and P. W. Smith, comps. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 24, 1964. Contract AT(45-1)-1350. 59p.

During the nineteen years of Hanford operation, waste management practices have included the dispersal of gaseous wastes in the atmosphere, the burial of solid wastes in the ground, the discharge of liquid wastes of low and intermediate radioactivity level to the ground, and the accumulation and confinement of liquid wastes of high radioactivity level in the underground tanks. During the past several years, the Chemical Processing Department has formulated a program to achieve significant improvements in the handling of high activity level radioactive wastes. This program has the objectives of assuring the safe confinement of the radioactive materials for centuries, minimizing the long-term cost of the storage and surveillance operations, and making selected fission products available for beneficial use. The improvement program has been approved in principle by the Atomic Energy Commission and is now being implemented. If the program is carried out as planned, it is expected that all high activity level liquid wastes will be solidified. The most radioactive wastes will be processed for cesium and strontium removal and packaging before the remainder is solidified. Processing of wastes will be on a current basis by about 1975. (auth)

33167 (LADC-5940) EVALUATION OF TEMPERATURE RISES IN RADIOACTIVE WASTES. E. F. Gloyna, M. Asce, H. J. Longley, and C. W. Christenson (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 50p.

Generalized numerical and analytical methods were developed for estimating rises in temperatures resulting from the storage of high-level wastes. Parametric relationships were considered, and solutions for the packed-bed, multi-region, variable-geometry, and variable-effective thermal conductivity system were evaluated. Solutions of the heat equation in one space dimension were obtained for plane, cylindrical, and spherical geometries. Three computer codes were developed, tested for accuracy, and compared. The codes represent three approximations to the actual physical situation. An auxiliary code was written to provide an estimate of the waste that could be put into a cavity when a maximum permissible temperature is specified. The accuracy of the solutions depends chiefly on the values of the input data and the variations of the parameters affecting the finite mesh and boundary conditions. The size of storage sites, concentration of wastes, and age of wastes have the greatest effect on the magnitude of the temperature. (auth)

33168 (SRIA-8) AN ANALYSIS OF LAND DISPOSAL OF PACKAGED RADIOACTIVE WASTE IN SEVEN WESTERN STATES. Final Report. R. B. Hoy, E. M. Kinderman, and R. R. Tarrice (Stanford Research Inst., Menlo Park, Calif.). Sept. 30, 1959. Contract AT(04-3)-115. 120p.

A preliminary study was made of possible areas in Western U. S. which might be used for future land burial of solid or packaged low-level radioactive wastes. The volume and nature of wastes generated in the seven western states were investigated. Fourteen areas in the states were selected as the best areas for further studies for disposal of packaged wastes. The costs of land disposal were also analyzed and compared with those for sea disposal. (D.L.C.)

33169 THE PURIFICATION OF RADIOACTIVE WASTE WATERS BY CONTACT PRECIPITATION. PART I. THE PRINCIPLE OF CONTACT PRECIPITATION. I. Mittag and G. Sachse (Zentralinstitut für Kernforschung Rossendorf, Ger.). Kernenergie, 7: 339-44(May 1964). (In German)

In the purification method described calcium carbonate is precipitated onto a contact mass, thereby eliminating the need for filtration and dehydration of the precipitate. The operation is continuous; however, removal of the precipitates (approximately 5 millimeter particle diameter) must be accomplished batchwise. The purified water has a German degree of hardness of 1°; further purification can be accomplished by means of ion-exchange columns. The techniques and apparatus are described in detail and typical results are presented. (OTS)

33170 METHOD AND DEVICE FOR THE REMOVAL OF LIQUID RADIOACTIVE WASTE. Rudolf Alberti. German Patent 1,166,392. Mar. 26, 1964. Filed Apr. 2, 1960.

A method was previously developed for solidifying liquid radioactive waste by bringing the radioactive liquid into a mixture of hydraulic binding agent and additions of granulated material. This method was improved by using a granulated material of polydispersed grain size distribution. The device for carrying out this method is composed of a system of communicating filling tubes. (Gmelin Inst.)

33171 RADIOACTIVE WASTE DISPOSAL. Gustav Boecker. German Patent 1,166,946. Apr. 2, 1964. Filed Jan. 10, 1961.

The solid waste is turned into compact formed bodies, which are insoluble in water. This forming is achieved by heating the waste material with the help of aluminothermics. A shielded container, into which a removable reaction vessel is inserted, is described. (Gmelin Inst.)

GENERAL AND MISCELLANEOUS

33172 (A/CONF.28/P/216) INTEGRATION OF NUCLEAR REACTORS AND POWER NETWORKS IN THE UNITED STATES; ECONOMIC AND TECHNICAL ASPECTS. Louis H. Roddis, Jr. (Pennsylvania Electric Co., Johnstown) and Emerson Jones. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Factors involved in the selection of nuclear power as the motive power for any arbitrarily chosen electricity generating station are reviewed, viz. cost to the consumer, availability to the consumer, dependability of the supply, quality of the service, and acceptability to the public. Examples of application of these factors are shown. (T.F.H.)

33173 (A/CONF.28/P/256) FUEL RESOURCES AND AVAILABILITY FOR CIVILIAN NUCLEAR POWER, 1964-2000. Rafford L. Faulkner (Atomic Energy Commission, Washington, D. C.) and William H. McVey. 15p.

Prepared for the United Nations Third International Conference on the Peaceful Uses of Atomic Energy, 1964.

Present and projected U.S. and world-wide U and Th usage for civilian power plants are outlined, and the reserves available to meet these usage requirements are estimated. The analyses are carried out through 1981. (T.F.H.)

33174 (BM-RI-6472) A CASE STUDY OF THE VALIDITY OF SCALING LAWS FOR EXPLOSION-GENERATED MOTION. Harry R. Nicholls (Bureau of Mines. Applied Physics Research Lab., College Park, Md.). Sept. 1963. 16p.

As part of the pre- and post-shot mine examination at Project GNOME, acceleration data were recorded underground from a series of chemical explosive shots. The cube root of the charge weight was used to scale acceleration and distance because charge weight was not constant. Regression analysis of particle acceleration-distance data gave the following propagation equation: $A\,W^{1/3} = 5.10 \times 10^{5} (R/W^{1/3})^{-2.43}$. The quantity $A\,W^{1/3}$ is scaled particle acceleration expressed in g's-lbs$^{1/3}$, and $R/W^{1/3}$ is scaled distance expressed in ft/lbs$^{1/3}$. Data obtained from the nuclear explosion were scaled and fall within one standard deviation of the calculated propagation law for the smaller shots. Cube root scaling laws were adequate to group acceleration data from explosive charges varying by a factor of more than 1×10^{7} in charge weight and over shot-to-gage distances varying from 100 to 46,000 feet. Data obtained from a series of small tests provided sufficient data from which reliable predictions of acceleration could be made for the large nuclear explosion. (auth)

33175 (BNL-7772) ACTIVATION ANALYSES FOR MEDICAL RESEARCH: THE USE OF STABLE SILVER AS A TRACER. L. G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). [June 1955]. Contract [AT(30-2)-Gen-16]. 50p. (CONF-588-1)

From Society for Nuclear Medicine 2nd Annual Meeting, Portland, Ore., June 1955.

A procedure is described for tracer studies in medical research in which stable Ag is used as a tracer and its presence is quantitatively determined by neutron activation of tissue samples and counting the ^{108}Ag activity. Neutron sources are discussed and suggested applications are outlined. (C.H.)

33176 (BNL-7915) OUTBIN—A 7090/94 BINARY PERIPHERAL COMPUTER OUTPUT SYSTEM. K. Fuchel and A. Legerlotz (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 5p. (CONF-582-1)

From SHARE XXII Meeting, San Francisco, Mar. 1964.

OUTBIN was developed as part of a program to increase the speed of I/O devices such as card readers, card punches, and printers, when peripheral computers are used as these devices. The Fortran subroutine (STH) is modified to write on an output tape both the format statement and its associated list. A binary computer then processes this output tape. It performs all necessary conversions, formats the print line, and prints at maximum speed (close to 1000 lines per minute). Time savings estimates for jobs using Fortran output and OUTBIN output are given. (R.E.U.)

33177 (CONF-556-1) THE KINETICS OF ALKALINE EARTH TRACER METABOLISM. Richard B. Holtzman (Argonne National Lab., Ill.). June 1964. Contract [W-31-109-eng-38]. 13p.

From 12th Annual Meeting of the Radiation Research Society, Miami, Fla., May 1964.

The kinetic aspects of alkaline earth tracer metabolism in man and animals are discussed. Emphasis is placed on use of the power function in mathematical analysis of data. Experimental data on ^{45}Ca metabolism and retention are used as an example. (C.H.)

33178 (COO-1198-172) AN INVESTIGATION OF THE ANNEALING OF QUENCHED-IN VACANCIES IN GOLD. J. A. Ytterhus, R. W. Siegel, and R. W. Balluffi (Illinois. Univ., Urbana). [1964]. Contract AT(11-1)-1198. 25p. (CONF-615-3)

From International Conference on Lattice Defects in Quenched Metals, Argonne, Ill., June 1964.

Gold wires, or ribbons, initially of 99.999% nominal purity, were pre-quench annealed for various periods in air at elevated temperatures by resistance heating and then quenched into brine at rates greater than 5×10^{4}°C sec^{-1}. The electric resistance annealing kinetics of the quenched-in defects were then investigated over a wide range of conditions. In a few cases quenched specimens were given small strains at room temperature to test the effects of straining on the subsequent annealing. Correlated measurements of the accompanying vacancy precipitation in the form of observable clusters were made in selected cases by trans mission electron microscopy. The following results were obtained: (1) The pre-quench air annealing reduced the dissolved impurity content in the grade of gold employed by increments in the ppm range. This was demonstrated by spectrographic analyses and residual resistivity measurements at 4.2°K; (2) the annealing rates varied drastically with the specimen purity. Highly purified specimens exhibited annealing half times 10^{2} longer than less purified specimens in certain cases; (3) the initial shapes of the annealing curves were very sensitive to the degree of post-quench holding near room temperature prior to annealing at higher temperatures; (4) a large increase in the density of vacancy precipitates observed after annealing occurred with increasing dissolved impurity content; (5) the effective migration energy E_{eff}^{m} was found to be 0.71 ± 0.03 ev for vacancy concentrations between 1.5×10^{-6} and 5×10^{-5}, for annealing temperatures between 30°C and 185°C, and for all specimen purities investigated; (6) at higher vacancy concentrations E_{eff}^{m} dropped to about 0.60 ev; (7) the post-quench straining increased the annealing rate but did not affect

E^m_{eff}. The impurity effects are explained by the extensive heterogeneous nucleation of vacancy precipitates by comparatively small impurity concentrations. This served to decrease the number of jumps to annihilation without affecting E^m_{eff}. The potential significance of such large impurity effects on annealing studies of nominally 99.999%, pure metals was pointed out. The effects of plastic straining were attributed to the introduction of dislocation sinks and possible precipitation sites at dislocation debris. (auth)

33179 (COO-1198-176) VACANCY MIGRATION TO SINKS DURING QUENCHES. C. P. Flynn, J. Bass, and D. Lazarus (Illinois. Univ., Urbana). [1964]. Contract AT(11-1)-1198. 22p. (CONF-615-2)

From International Conference on Lattice Defects in Quenched Metals, Argonne, Ill., June 1964.

A theory is presented which predicts that the fraction of the thermal equilibrium vacancy concentration at the quench temperature T_q, which is lost to fixed sinks during a linear quench, depends only on the product $D_q T_q \tau_q$. Here, D_q is the diffusion coefficient of the vacancies at the quench temperature and τ_q is the quench time. The results of a series of quenching measurements on gold wires during which τ_q was varied over a range of 2×10^2 and T_q over a temperature range of 500°C are in good agreement with the theory, thereby allowing one to investigate the high temperature mobility of the vacancies. The experimental results determine both E_m and E_F in terms of Q. For Q = 1.81 ± 0.02 ev, E_F = 0.98 ± 0.02 ev and E_m = 0.83 ∓ 0.04 ev were found. The measured fractional vacancy loss suggests that the majority of the vacancies are annihilated at sinks other than the grain boundaries. (auth)

33180 (COO-1198-178) ON PROBLEMS ASSOCIATED WITH THE ANALYSIS OF COMPLEX ANNEALING KINETICS IN QUENCHED METALS: ANNEALING MODEL FOR QUENCHED GOLD. R. W. Balluffi and R. W. Siegel (Illinois. Univ., Urbana). [1964]. Contract AT(11-1)-1198. 28p. (CONF-615-1)

From International Conference on Lattice Defects in Quenched Metals, Argonne, Ill., June 1964.

The problem of analyzing complex quenching experiments in which several mobile defect types may be present and in which concurrent nucleation and precipitation may occur is considered. The following relevant topics are discussed: (1) a general model applicable to fairly complex annealing situations, and the behavior of this model under conditions where local equilibrium between the annealing defects may or may not be achieved; (2) the effective migration energy, E^m_{eff}, of the annealing process as determined by the change of slope method, the Palmer method and from Arrhenius plots; (3) a number of previously neglected aspects of the determination of E^m_{eff} in this model; and (4) several procedures for the analysis of data. The annealing data for quenched gold are then discussed in the light of the above considerations. The previous model proposed by Koehler and coworkers is found to be inconsistent with the present data. It is concluded that the observed migration energy of 0.71 ev most probably corresponds to that of the divacancy possessing a binding energy greater than about 0.3 ev. Only limited conclusions can be reached regarding other aspects of the data. Formidable problems remain in reaching a relatively complete understanding of quenched gold. It is emphasized that there is an urgent need in the quenching field for: (1) further development of realistic models; (2) obtaining experimental data which are more accurate and comprehensive than has been customary in the past; and (3) development of more powerful experimental techniques capable of monitoring the behavior of specific defect types. (auth)

33181 (EGG-1183-1019) CABLE HARDENING STUDY FOR PILE DRIVER. Tech. Memo No. L-74. R. A. Shunk (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.). Feb. 4, 1963. Contract AT(29-1)-1183. 31p.

Experiments were conducted to determine the requirements for protecting the signal cables connecting transducer locations in a tunnel to recording stations above ground. Hardened structures tested included H beams with channels bolted over the open parts of the H, drill stem, and double extra strong steel pipe, and the cables used were shielded cable and coaxial cable. Rock fly impacts were simulated by propelling concrete blocks into the structures, and cable noise and rock fly velocities were measured. The reactions of the structures to the impacting block are described, and recommendations are made for cable ducts in various tunnel positions. (D.L.C.)

33182 (HMI-B-34) JAHRESBERICHT 1963. (Yearly Report 1963). (Hahn-Meitner-Institut für Kernforschung, Berlin). June 1964. 148p.

The 1963 Annual Report of the Hahn-Meitner-Institut für Kernforschung is presented, and it includes the work done in nuclear chemistry, mathematics, nuclear physics, radiochemistry, electronics, reactor physics, and radiophysics. Publications by the various sections are listed, and abstracts of some of them are given. The work in progress is indicated. Backgrounds of new studies initiated this year are reviewed. Training sessions and symposia held by the different sections are tabulated. (J.S.R.)

33183 (LADC-5902) IDENTIFICATION OF N-NITROSO- AND NITRODIPHENYLAMINES BY TWO-DIMENSIONAL THIN-LAYER CHROMATOGRAPHY. Stanley K. Yasuda (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 12p.

A two-dimensional thin layer chromatographic method, capable of separating and identifying nineteen N-nitroso- and nitrodiphenylamines, is described. The method is applied to the analysis of diphenylamine/N_2O_4 and 2-nitroDPA/N_2O_4 reaction products and the stabilizer fraction of a plastic bonded explosive. A spray reagent, p-diethylaminobenzaldehyde, used in conjunction with silica gel G/Zn plates, offers a sensitive detection method for each diphenylamine derivative. (auth)

33184 (LADC-5909) THE EFFECT OF STRAIN AGING ON THE DYNAMIC ELASTIC-PLASTIC PROPERTIES OF IRON. John W. Taylor and Eugene G. Zukas (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 29p.

Strain-aging experiments with cold worked iron specimens show that twinning can occur during plane wave shock loading after the specimens have been permitted to recover over an extended time interval. There is a thermal activation energy of 20 kilocalories per mole associated with this recovery. The absolute times involved are, however, much too long to be explained on the basis of the Cottrell-Bilby theory of strain aging. Twinning was found to be unimportant to the dynamic yielding process. After straining, the recovery of the elastic-plastic wave structure, characteristic of fully annealed iron, proceeds with an activation energy greater than 130 kilocalories per mole. (auth)

33185 (NYO-901-9) ACTIVATION OF TRYPTOPHAN PYRROLASE BY REDUCTION AND HEMATIN. W. Eugene Knox and K. Tokuyama (Harvard Univ., Boston, Medical School and New England Deaconess Hospital, Boston). June 8, 1964. Contract AT(30-1)-901. 18p. (CONF-549-1)

From International Symposium on Oxidases and Related Oxidation-Reduction Systems, Amherst, Mass., July 1964.

Results are reported from studies on the activation of tryptophan pyrrolase by reduction and hematin. Data are reported on reaction mechanisms for tryptophan pyrrolase of rat liver and Pseudomonas bacteria. Results indicated an analogy between the three forms of hemoglobin and the three forms of tryptophan pyrrolase. (C.H.)

33186 (SC-4980(RR)) PHOTOELASTIC STUDIES OF STRESS PROPAGATION. S. E. Whitcomb (Sandia Lab., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 120p.

The center of the upper edge of a rectangular CR-39 specimen was impacted by a round-nosed projectile traveling at speeds of from 90 to 280 ft/sec. The resulting photoelastic patterns were photographed at 5-microsecond intervals until 1 millisecond after impact. The horizontal and vertical components of stress along the symmetry axis were calculated as a function of time after impact, using the method of oblique incidence. The results agree reasonably well with those from strain gage measurements. The initial fringe velocity, initial rate of stress increase, and maximum fringe displacement for the first pulse were expressed in terms of fringe order, impact velocity, and distance from the impact point. The fringe orders observed along the symmetry axis were accounted for by considering the initial pulse and pulses reflected from the boundaries of the specimen. (auth)

33187 (SC-DC-64-1016) HYPERSONIC FORCE TESTS OF THE 1/10 SCALE RFD-2 CONFIGURATION FOR THE SANDIA CORPORATION. Report No. 110-603-1. Gene A. Hironimus (Cornell Aeronautical Lab., Inc., Buffalo). [1963]. For Sandia Corp., Albuquerque, N. Mex.). Contract AT(29-1)-789. 100p.

Tests to determine the aerodynamic forces and moments on the RFD-2 shape were carried out in the 48 in. Leg of the Experimental Facilities Division Hypersonic Shock Tunnel during November 1963. The model had three interchangeable noses, which were designed as Configurations I, II, and III. Spoiler bands were also located on the model in two different positions and designated Configurations IB and IC. Configurations I and II were tested at Mach numbers 12 and 17 and at respective Reynolds numbers of 8×10^4 and 1.08×10^5 per foot in the contoured nozzle, and at Mach numbers of 17 and 22.3 at respective Reynolds numbers of 1.08×10^5 and 5×10^4 per foot in the conical nozzle. The angle of attack range was from −6° through 20°. Configurations IB and IC were tested at Mach numbers of 17 and 22.3 at respective Reynolds numbers of 1.08×10^5 and 5×10^4 per foot through an angle of attack range from 0° to 20° in the conical nozzle. Configuration III was tested at Mach numbers of 12, 17, and 12.3 at respective Reynolds numbers of 8×10^4, 1.08×10^5, and 5×10^5 per foot through an angle of attack range from −6° to 20° in the contoured nozzle. (auth)

33188 (SC-R-64-123) STERILIZATION—AN EXAMPLE OF RELIABILITY IMPROVEMENT THROUGH MONITORING. W. F. Jemison (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract AT(29-1)-789. 24p. (CONF-591-1)

From American Institute of Electrical Engineers Summer General Meeting, Denver, Colo., June 1962.

Sterilization in monitoring consists of sensing an unwanted or dangerous situation in a circuit and rendering the circuit impotent. In a single-channel system, sterilization will control unwanted or dangerous situations at the expense of no output. In a dual-channel system, sterilization will control unwanted or dangerous situations and also considerably increase reliability; the system will be almost as reliable as a series-parallel net and will be considerably reduced in size and weight. A sterilizing monitor does not have to be extremely reliable to be effective. (auth)

33189 (SC-R-64-148) PROCESS START AND CONTROL PROCEDURES. T. P. Conlon (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract [AT(29-1)-789]. 31p.

Procedures are described for the rapid application of sequential analysis in process control engineering. The procedures are used to verify process settings either at setup or at periodic intervals during the production run. Example problems are given at three quality levels. (D.L.C.)

33190 (SC-R-64-181) PHOTOCONDUCTIVITY IN ORGANIC MOLECULAR CRYSTALS. R. G. Kepler (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 13p. (CONF-617-1)

From Special Technical Conference on Nuclear Radiation Effects, Seattle, July 1964.

An attempt has been made to show that considerable progress has been made over the last four or five years in the study of the electronic properties of organic molecular crystals. Generally speaking, the experimental techniques which have been most informative are those which involve transient techniques. The data obtained from d-c experiments usually are dominated by space charge and electrode effects. A surprisingly good agreement between a rather simple theory and experiment has been obtained, but considerably more testing of the theory is necessary. And, finally, the mechanism of carrier generation is still a very interesting problem that has not been solved. Excitons are almost certainly involved, but just how has not been resolved. (auth)

33191 (SC-RR-64-512) INCREASING THE DENSITY OF INFORMATION RECORDED ON MAGNETIC DRUMS. (Frankel (Sidney) and Associates, Menlo Park, Calif.). June 1964. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 70p.

Studies were made of the possible theoretical and design approaches to improve the storage and retrieval capabilities of magnetic drums. Emphasis was placed on the problem of optimum synthesis of the readout circuit, and the "Wiener filter" approach was chosen. It is concluded that improvement factors of 2 to 4 should be possible, and that filter transmission characteristics should be shaped in accordance with the physical properties of signal and noise. (D.L.C.)

33192 (SC-TM-64-28) A KERR CELL SYSTEM FOR MEASURING THE AMPLITUDE OF HIGH-VOLTAGE NONRECURRING PULSES. D. C. Wunsch (Sandia Lab., Albuquerque, N. Mex.). June 1964. Contract AT(29-1)-789. 86p.

A system is described that measures high-voltage pulses with very high resolution. This system is based on a unique application of the electro-optic Kerr effect and measures voltage pulses with magnitudes from 30,000 to 100,000 volts. This technique could also be used to measure higher voltages by changing the separation of the Kerr cell plates. The system has a linear frequency response to approximately 100 megacycles. Unlike the resolution of other voltage-measuring systems, the resolution of this system increases as the voltage pulse increases towards its peak value. The peak pulse magnitude can be measured with a resolution of better than 0.1 percent. The system can be

calibrated so that the measured value of the peak voltage should be accurate to within ±1 percent of the true value. (auth)

33193 (SC-TM-64-637) STANDARD TESTS FOR LAMINAR FLOW DEVICES. R. C. Marsh, W. J. Whitfield, W. E. Neitzel, J. C. Mashburn, and L. C. Trujillo (Sandia Lab., Albuquerque, N. Mex.). June 1964. Contract [AT (19-1)-789]. 38p.

A discussion is presented of the need for testing laminar flow devices to assure that they are functioning properly. Detailed procedures are given for testing air flow and for leak-checking the final filters, and methods of correcting deficiencies are outlined. (auth)

33194 (TEI-838) CHEMISTRY AND MOVEMENT OF GROUND WATER, NEVADA TEST SITE. Stuart L. Schoff and John E. Moore (Geological Survey, Washington, D. C.). 1964. 111p.

Three chemical types of ground water are distinguished at the Nevada Test Site and vicinity. A sodium-potassium water is related to tuff (in part zeolitized) and to alluvium containing detrital tuff. A calcium-magnesium water is related to limestone and dolomite, or to alluvium containing detritus of these rock types. A mixed chemical type, containing about as much sodium and potassium as calcium and magnesium, may result from the addition of one of the first two types of water to the other; to passage of water first through tuff and then through carbonate rock, or vice versa; and to ion exchange during water travel. Consideration of the distribution of these water types, together with the distribution of sodium in the water and progressive changes in the dissolved solids, suggests that the ground water in the Nevada Test Site probably moves toward the Amargosa Desert, not into Indian Spring Valley and thence southeastward toward Las Vegas. The low dissolved solids content of ground-water reservoirs in alluvium and tuff to the enclosed basins indicates that recharge is local in orgin. (auth)

33195 (TID-20832) A STUDY OF CERTAIN ASPECTS OF THE FAILURE OF KLYSTRON WINDOWS. First Bi-Monthly Report. (Stanford Univ., Calif. Stanford Linear Accelerator Center). [nd]. Contract AT(04-3)-363. 17p.

The causes of klystron window failures in the Stanford accelerator environment are examined. From preliminary r-f experiments, it appears that excitation of the ghost-mode can lead to destruction of a window at even modest power levels. A number of ways to shift the ghost mode down into the range of the operating frequency is being studied. An optical microscopic inspection of window failures is summarized. (N.W.R.)

33196 (TID-20857) THE POLAROGRAPHIC REDUCTIONS OF 2,2′-BIPYRIDINE AND SOME OF ITS COMPLEXES WITH CHROMIUM(III) (thesis). Beverly V. Tucker (Purdue Univ., Lafayette, Ind.). June 1964. Contract [AT (11-1)-1222]. 93p.

The reduction of 2,2′-bipyridine at dropping-mercury electrode was studied in buffered aqueous solutions using polarography, controlled-potential electrolysis, and cyclic triangular-wave voltammetry. Three polarographic waves were observed and designated as a prewave, a first, and a second wave. The prewave was due to adsorption of the reduced 2,2′-bipyridine on the mercury drop. The first wave was primarily due to the two-electron reduction of 2,2′-bipyridine. An electro-active intermediate, with a half-life of the order of 6×10^{-3} seconds, was formed and reacted, most probably with the solvent, to form an electro-inactive product. Coulometry experiments indicated that some catalytic hydrogen evolution was also occurring on the first wave. The second wave, which was a catalytic hydrogen wave, was probably due to reduced 2,2′-bipyridine catalyzing the evolution of hydrogen. A structure for the reduction product was postulated using coulometric and infrared spectral data plus known chemistry of related systems. The reduction product was postulated to be 2,2′-pyridyl-1,4-dihydropyridine. The electrochemical reductions of $Cr(Bipy)_3(ClO_4)_3 \cdot 3H_2O$, $Cr(Bipy_2Cl_2)Cl \cdot 2H_2O$, and $Cr(Bipy_2ClH_2O)(ClO_4)_2 \cdot 2H_2O$ were studied in water, 86 per cent ethanol, methanol, and absolute ethanol using polarography and controlled-potential electrolysis. Reductions to the chromium(II), (I), and (0) 2,2′-bipyridine complexes were observed. A 2,2′-bipyridine molecule was released in the first reduction step of $Cr(Bipy)_3(ClO_4)_3 \cdot 3H_2O$, and its further reduction was similar to that of the other two complexes. As the dielecrtic constant of the solvent decreased, the first polarographic wave of $Cr(Bipy_2Cl_2)Cl \cdot 2H_2O$ and $Cr(Bipy_2ClH_2O)(ClO_4)_2 \cdot 2H_2O$ and the first and second polarographic waves of $Cr(Bipy)_3(ClO_4)_3 \cdot 3H_2O$ became less cathodic. The remaining portion of the polarogram of each complex varied with solvent, but followed no comparable trends. Electrolysis at a mercury-pool cathode did not always strictly follow reduction at the dropping-mercury electrode; reduction to the low valent complexes did occur, but so did secondary reactions in solution. All three complexes were reduced in relatively the same manner to the lower valent chromium 2,2′-bipyridine complexes, and the reductions were found to be a function of solvent. Liquid-liquid extraction data indicated that the air-oxidation product, after reduction to the chromium (0) 2,2′-bipyridine complex at a mercury-pool cathode, was a mono-2,2′-bipyridylchromium(III) complex, the formation of which was independent of solvent and initial species. (auth)

33197 (TID-20863) STUDY OF ASPECTS OF FAILURE OF KLYSTRON WINDOWS. Final Report. D. A. Daly, H. B. Law, and L. S. Nergaard (Radio Corp. of America. RCA Labs., Princeton, N. J.). Apr. 15, 1963. For Stanford Univ., Calif. Stanford Linear Accelerator Center. Contract AT(04-3)-363. 16p.

The object of the work is to examine the causes of klystron window failure in the Stanford accelerator environment, to develop a model for the failure mechanism so that better windows can be achieved and/or operating conditions can be found that will provide maximum window life. Out of a critical analysis of failed windows and of test data, both supplied by Stanford, a model has evolved: failure is due to internal damage caused by gas discharges in the pores of the ceramic at high field strengths; the high field strengths arise from an unloaded higher-order mode, anchored at the window by the discontinuity in dielectric constant at the window-vacuum interface and made resonant at the operating frequency by a dilute plasma in the vacuum. The plasma is sustained by multipactoring. The model accounts for most of the known effects observed in window operation. (auth)

33198 (UCLA-12-528) INFLUENCE OF PHYSOSTIGMINE AND NEOSTIGMINE ON THE RESPONSES OF GOLDFISH INTESTINE TO ACETYLCHOLINE. Thomas J. Haley, G. Colvin, and M. Efros (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [196?]. Contract AT-04-1-GEN-12. 8p.

The use of a micro-bath and electronic amplification of the contractions of the goldfish intestine makes it possible to estimate acetylcholine in concentrations of 0.5 to 2.5×10^{-9}. Addition of esterase inhibitors increases the sensi-

tivity of the preparation, but it is not as sensitive as the leach muscle. Physostigmine and neostigmine also cause contractions of the goldfish intestine. (auth)

33199 (UCRL-10811) THE REAL AND IDEAL STRENGTHS OF THE COMMON STRUCTURAL METALS. Victor F. Zackay (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). June 18, 1963. Contract W-7405-eng-48. 41p.

The load-bearing capacity of a structural material is, perhaps, its most important property. The reliable prediction of this property with extreme environments and under complex conditions of stress and load applications is one of the materials engineer's most formidable problems. It is all too apparent at present that materials science has not yet progressed far enough that the complex engineering properties of solids can be described in terms of fundamental quantities. A brief survey is presented of the progress that has been made in understanding the fundamental nature of the strength of crystalline solids. The essential differences between brittle and ductile crystalline solids are first discussed. Several of the effective strengthening mechanisms of ductile solids are then reviewed. The discrepancy between the theoretical and the actual strength-weight ratios of each of the common structural metals is next examined over a wide range of temperatures. Finally, two recent high-strength iron-base alloys, designed for use in the temperature range of 0 to 1000°F, are described very briefly. (auth)

33200 (UCRL-10871) DISLOCATION ETCH PITS IN HEXAGONAL Ag–Al INTERMETALLIC PHASE. Joy George and J. D. Mote (California. Univ., Berkeley. Lawrence Radiation Lab.). July 10, 1963. Contract W-7405-eng-48. 7p.

Single crystals of hexagonal Ag–Al alloy containing 33 at. % Al were etched with a H_2SO_4–H_2O_2–HF reagent. The resulting pits were hexagonal in shape and randomly distributed on the (0001) plane. The counts of the pits in three- and two-branch boundaries agree with these predicted from edge dislocations. The pits also appear along slip traces, and it is concluded that the etch pits are sites of dislocations. (D.L.C.)

33201 (UCRL-10916) THE RATE-CONTROLLING MECHANISM OF SLIP IN THE INTERMETALLIC COMPOUND AgMg AT LOW TEMPERATURES. A. K. Mukherjee and John E. Dorn (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 12, 1963. Contract W-7405-eng-48. 22p.

The effect of strain rate and temperature on the critical resolved shear stress for $(\bar{3}21)$ [111] slip was determined for the CsCl type of intermetallic compound AgMg. The flow stress increased only slightly as the test temperature was first decreased below room temperature, but a rapid increase in the flow stress was obtained with yet further decrease in temperature from about 250°K to 4°K. The effect of both the temperature and strain rate on the flow stress over the low temperature range could be rationalized satisfactorily in terms of the Peierls mechanism when the deformation was controlled by the rate of nucleation of pairs of kinks. (auth)

33202 (UCRL-10917) ON THE LOW-TEMPERATURE THERMALLY-ACTIVATED MECHANISM FOR PRISMATIC SLIP IN THE Ag–Al INTERMEDIATE HEXAGONAL PHASE. A. Rosen, J. D. Mote, and J. E. Dorn (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 14, 1963. Contract W-7405-eng-48. 20p.

The effect of strain rate and temperature on the critical resolved shear stress for $(\bar{1}100)$ $[11\bar{2}0]$ prismatic slip was determined for the intermediate hexagonal phase containing about 67 at. % Ag and 33 at. % Al. Whereas the flow stress increased only slightly as the test temperature was first decreased below room temperature, a rapid increase in the flow stress was obtained with yet greater decreases in temperature from about 240°K to 4°K. The effect of both temperature and strain rate on the flow stress over the low-temperature range could be completely rationalized in terms of the Peierls mechanism when the deformation is controlled by the rate of nucleation of pairs of kinks. (auth)

33203 (UCRL-11213) CHEMISTRY DIVISION ANNUAL REPORT, 1963. J. M. Hollander, F. L. Reynolds, and J. C. Wallmann, eds. (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1964. Contract W-7405-eng-48. 200p.

Progress is reported in the following sections: radioactivity and nuclear structure, fission, nuclear reactions, physical chemistry, instrumentation, and chemical engineering. Separate abstracts were prepared for all six sections. (D.L.C.)

For abstracts of individual chapters see: 31361, 31362, 32281, 32745, 32746, and 32747.

33204 (UCRL-11317) INORGANIC MATERIALS RESEARCH DIVISION ANNUAL REPORT 1963. (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 25, 1964. Contract W-7405-eng-48. 254p.

Twelve abstracts are presented on the technical sections of the report dealing with chemistry, metallurgy, and reactor materials. (N.W.R.)

For abstracts of individual sections see: 31431, 31432, 31433, 31434, 31435, 32061, 32148, 32149, 32150, 32151, 32152, and 32153.

33205 (Y-1463) PRECISION TURNING. F. H. Broome and V. M. Hovis (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 23, 1963. Contract W-7405-eng-26. 15p.

Spherical test specimens possessing an overall dimensional conformity within ±20 microinches and a surface-finish value of one microinch have been made of aluminum, nickel, and copper. This high-quality finish has been achieved by the direct use of single-point tool techniques without the usual additional work of lapping, buffing, or polishing. Machine tools are now available which are capable of microinch precision in supporting a work piece and guiding a diamond knife along a desired path during a cutting operation. (auth)

33206 SOME PROBLEMS CONCERNING LIABILITY FOR ATOMIC INJURIES. PART II. N. Pelzer. Atomwirtschaft, 9: 277–81(June 1964). (In German)

The Atomic Liability Law in Germany is considered to show deficiencies on a few basic issues so that it does not provide in all cases a positive financial protection against the hazards of nuclear energy. The problem of delayed damages, which only become known after claims for compensation become invalidated by the statute of limitations, is discussed. In particular, difficulties were found to arise in the case of liability for genetic damages. It is considered advisable, as was done in Switzerland, to set up a fund for delayed damages from which compensation can be paid for claims barred by the statute of limitations. Further the problem of the proof of causality in the case of radiation injuries is still unsolved. This cannot be remedied by the general rules of evidence of German Law. A careful limitation of the principle of causality must be

contemplated. In the case of persons exposed to radiation professionally a refutable supposition of the causality connection in the case of typical and probable radiation illness seemed the most practical solution. Whether the protection of the rest of the population can be guaranteed in the same way is considered more than questionable. (auth)

33207 ECONOMIC ASPECTS OF NUCLEAR ENERGY. I. PRICE OF URANIUM. F. Pascual Martinez, M. Lopez Rodriguez, and E. Delgado Hernandez (Junta de Energia Nuclear, [Madrid]). Energia Nucl. (Madrid), 8: 12-25 (Jan.-Mar. 1964). (In Spanish)

Since 1955 there has been a substantial reduction in the cost of natural uranium. The evolution of this reduction is discussed by a resumé of the change in the price of uranium concentrates, in the unit cost of separation, value of improverished uranium, and concentration of ^{235}U in natural uranium. The effects of the separation, optimum composition of tailings, and unit cost of material of composition x_p on the cost or enriched uranium are examined theoretically. Applications to fixing the price of enriched uranium are given. The effect of the fuel cost on the fuel cycle in enriched reactors is shown. (J.S.R.)

33208 EDUCATION AND TRAINING FOR NUCLEAR TECHNOLOGISTS. Sakuji Komagata (Atomic Energy Committee, Japan) and Akira Oyama. Genshiryoku Hatsuden, 7: No. 2, 1-36(June 1963). (In Japanese)

The present state of and future plans for education and training of nuclear technologists at national and private universities and institutions and industrial corporations are described. Methods of training and education are first considered. The plans at each university, institution, etc., are as follows: Division of Nuclear Engineering, Department of Engineering, Univ. of Tokyo, production of nuclear experts for the development of nuclear power including the design of reactors; Tokyo Institute of Technology, the curricula of the post-graduate course; Tokai Univ., the problems of education and training; Japan Atomic Energy Research Institute, future plans and the Radioisotope School and the Nuclear Engineering School of the Institute; National Institute of Radiological Sciences, present education and training and future plans. The industrial corporations where education and training are performed and described include the following: the First Atomic Power Industry Group (FAPIG), Nippon Atomic Industry Group (NAIG), Tokyo Atomic Industrial Consortium (TAIC), Mitsubishi Atomic Power Industries Incorporated (MAPI), Sumitomo Atomic Power Group, and Japan Atomic Power Co. (NSA of Japan)

33209 WISSENSCHAFTLICHE JAHRESTAGUNG DER GESELLSCHAFT FUR ANGEWANDTE MATHEMATIK UND MECHANIK IN KARLSRUHE (16-20 APRIL 1963). (Annual Scientific Meeting of the Society for Applied Mathematics and Mechanics in Karlsruhe (April 16 to 20, 1963). Z. Angew. Math. Mech., 43: T1-187(1963).

Sixty-five papers presented at the Annual Scientific Meeting of the Society for Applied Mathematics and Mechanics in Karlsruhe, April 16 to 20, 1963 are given. The papers are grouped under the following headings: applied mathematics, probability and statistics, mechanics, and flow mechanics. Separate abstracts were prepared for 2 papers. (M.C.G.)

For abstracts of individual papers see: 32722 and 32723.

33210 EURATOM INFORMATION. Vol. 2, Nos. 5-6, 255-370, June 1964. (European Atomic Energy Community). 122p. $15.00 per yr. (Verlag Handelsblatt GmbH, Dusseldorf, Ger.).

A cumulative list of the EURATOM-United States contracts and other EURATOM contracts entered into force before March 31, 1964, is presented under the following headings: reactor technology, reactor materials, physics, waste disposal and processing, radiation chemistry, radiobiology, and radioisotopes. The scope of programs contracted for during the report period is outlined. Technical progress is reviewed. (N.W.R.)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

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The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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246	18-33056	Dep.(mn); $1.00(OTS)
247	18-33086	Dep.(mn); $1.00(OTS)
248	18-33057	Dep.(mn); $1.00(OTS)
249	18-33058	Dep.(mn); $1.00(OTS)
250	18-31647	Dep.(mn); $1.00(OTS)
251	18-31648	Dep.(mn); $1.00(OTS)
252	18-31649	Dep.(mn); $1.00(OTS)
253	18-32031	Dep.(mn); $1.00(OTS)
254	18-32032	Dep.(mn); $1.00(OTS)
255	18-32033	Dep.(mn); $1.00(OTS)
256	18-33173	Dep.(mn); $1.00(OTS)
257	18-31745	Dep.(mn); $1.00(OTS)
258	18-33010	Dep.(mn); $1.00(OTS)
259	18-33011	Dep.(mn); $1.00(OTS)
260	18-32977	Dep.(mn); $1.00(OTS)
261	18-32709	Dep.(mn); $1.00(OTS)
262	18-32724	Dep.(mn); $1.00(OTS)
263	18-32959	Dep.(mn); $1.00(OTS)
264	18-33012	Dep.(mn); $1.00(OTS)
265	18-33013	Dep.(mn); $1.00(OTS)
266	18-33087	Dep.(mn); $1.00(OTS)
267	18-33088	Dep.(mn); $1.00(OTS)
268	18-33014	Dep.(mn); $1.00(OTS)
269	18-32725	Dep.(mn); $1.00(OTS)
270	18-33015	Dep.(mn); $1.00(OTS)
271	18-33016	Dep.(mn); $1.00(OTS)
272	18-32960	Dep.(mn); $1.00(OTS)
273	18-33089	Dep.(mn); $1.00(OTS)
274	18-33090	Dep.(mn); $1.00(OTS)
275	18-32961	Dep.(mn); $1.00(OTS)
276	18-33091	Dep.(mn); $1.00(OTS)
278	18-31650	Dep.(mn); $1.00(OTS)
279	18-31780	Dep.(mn); $1.00(OTS)
280	18-31651	Dep.(mn); $1.00(OTS)
281	18-31652	Dep.(mn); $1.00(OTS)
282	18-32962	Dep.(mn); $1.00(OTS)
283	18-33092	Dep.(mn); $1.00(OTS)
284	18-33017	Dep.(mn); $1.00(OTS)
285	18-32963	Dep.(mn); $1.00(OTS)
286	18-31781	Dep.(mn); $1.00(OTS)
287	18-33160	Dep.(mn); $1.00(OTS)
288	18-31782	Dep.(mn); $1.00(OTS)
290	18-31996	Dep.(mn); $1.00(OTS)
291	18-31688	Dep.(mn); $1.00(OTS)
292	18-33122	Dep.(mn); $1.00(OTS)
868	18-33161	Dep.(mn); $1.00(OTS)
869	18-33162	Dep.(mn); $1.00(OTS)
ACNP–	**(Misc.)**	
64014	18-33093	Dep.(mc); $8.10(fs), $2.69(mf) OTS
64024	18-33094	Dep.(mc); $2.60(fs), $0.89(mf) OTS
AD–	**(Misc.)**	
423841	18-32154	See WADD-TR-60-37(Pt.IV)
427279	18-31259	$1.60(OTS)
428066	18-32337	$1.60(OTS)
428169	18-32679	$12.00(OTS)
428970	18-31836	See ASD-TDR-63-697
429154	18-32883	See AFCRL-63-782(Vol.III)
429439	18-31864	$5.60(OTS)
429919	18-31563	$2.60(OTS)
430158	18-33095	$8.10(OTS)
430359	18-31131	See RRA-T42
431156	18-31794	See R64SD-1
600261	18-31740	See FMRC-15328
601487	18-31722	See MTI-64TR-25
601625	18-32750	See USNRDL-TR-742
602285	18-32509	OTS
602890	18-31754	See NDL-TR-58(Pt.I)
602897	18-31755	See NDL-TR-58(Pt.II)
AE–	**(Non-AEC)**	
144	18-31865	Dep.(mc)
145	18-32011	Dep.(mc)
AEC-tr–		
6438	18-31375	Dep.(mc); $1.10(fs), $0.80(mf) JCL
AECL–	**(Canadian)**	
949(App.7)	18-33099	See CRRP-872(App.7)
1918	18-33165	See ERI-6
1929	18-33018	See CRRP-627
1941	18-31366	See CRDC-1193
1971	18-32277	See PR-P-61
1978	18-32012	Dep.; $1.50(AECL)
1988	18-33096	Dep.; $0.50(AECL)
AEET-ROD–	**(Indian)**	
11	18-33140	Dep.(mc)
AEEW-R–	**(British)**	
300	18-32013	Dep.(mc)

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370	18-32710	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
AERE-HP–	**(British)**	
GEN-39	18-31751	Dep.(mc)
AERE-M–	**(British)**	
1218	18-32099	Dep.(mc)
1261	18-32100	Dep.; $0.90(BIS); 4s. 6d. (HMSO)
AERE-NP–	**(British)**	
GEN-29	18-32711	Dep.(mc)
AERE-R–	**(British)**	
4243	18-32240	Carbon, 1: 189-200(1964)
4390	18-32245	J. Less-Common Metals, 6: 472-83(1964)
4588	18-31416	Dep.; $0.80(BIS); 4s. (HMSO)
4637	18-31357	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
4649	18-32726	Dep.
AFCRL–	**(Non-AEC)**	
63-782(Vol.III)	18-32883	$13.00(OTS)
AI-Trans–		
48	18-32114	Dep.(mc); $1.60(fs), $0.80(mf) JCL
ANL–		
6789	18-33097	Dep.; $2.00(OTS)
6816	18-32129	Dep.; $0.50(OTS)
ANL-Trans–		
43	18-32021	Dep.(mc); $1.10(fs), $0.80(mf) JCL
44	18-33151	Dep.(mc); $2.60(fs), $1.07(mf) JCL or OTS
47	18-32022	Dep.(mc); $2.60(fs), $1.04(mf) JCL
APEX–		
674	18-32083	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ARA–	**(Non-AEC)**	
1052	18-31746	
ARL–	**(Non-AEC)**	
64-63	18-32130	OTS
ASD-TDR–	**(Non-AEC)**	
63-360(Pt.II)	18-32131	OTS
63-697	18-31836	$0.75(OTS)
63-741(Vol.I) (Suppl.I)	18-32132	
63-741(Vol.II) (Suppl.I)	18-32133	
ATR-FE–		
100	18-33145	See IDO-24463
102	18-33146	See IDO-24465
103	18-33147	See IDO-24466
ATR-IC–		
100	18-33144	See IDO-24462
AWRE-O–	**(British)**	
17/64	18-32360	
22/64	18-31417	Dep.(mc)
26/64	18-31866	Dep.(mc)
BLG–	**(Belgian)**	
190	18-32217	Dep.(mc)
204	18-32218	Dep.(mc)
232	18-31691	Dep.(mc)
243	18-31752	Dep.(mc)
BM-RI–	**(Misc.)**	
6304	18-32034	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6465	18-31867	Free(Bureau of Mines)
6472	18-33174	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6480	18-32134	Free(Bureau of Mines)
BMI-X–		
296	18-32135	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10073	18-32035	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10091	18-32036	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10092	18-32037	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10093	18-32136	Dep.(mc); $1.60(fs), $0.80(mf) OTS
BNL–		
832	18-33163	Dep.; $0.75(OTS)
846	18-32727	Dep.; $2.50(OTS)
848	18-31983	Dep.; $0.75(OTS)
850	18-31868	Dep.; $0.50(OTS)
859	18-32259	Dep.; $0.50(OTS)
863	18-32014	Dep.; $1.00(OTS)
6995	18-31281	Maryland State Med. J., 1-8(1963)
7364	18-31811	Hospitals, 38: 50-6(1964)
7397	18-31986	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7452	18-32264	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-028-19
7554	18-31076	Nature, 201: 722-3(1964)
7654	18-31496	J. Phys. Chem., 68: 2020-1(1964)
7743	18-32833	Phys. Rev., 135: B587-91(1964)
7772	18-33175	$4.60(fs), $1.70(mf) OTS
7915	18-33176	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7919	18-31871	See CERN-64-30(p.11-20)
7941	18-32607	Phys. Rev. Letters, 13: 37-40(1964)
8029	18-32830	Phys. Letters, 10: 358-9(1964)
8041	18-32608	Phys. Rev. Letters, 13: 40-2(1964)
8076	18-32846	Phys. Rev. Letters, 13: 26-9(1964)
BPR-XIII–		
3/4-64	18-31730	See TID-20789
CAPE–		
1057	18-31973	EM
1059	18-31833	EM
1097	18-32982	EM
1098	18-31975	EM
1100	18-31682	EM
1112	18-31702	EM
1114	18-31703	EM
1116	18-31974	EM
CEA-R–	**(French)**	
2320	18-31125	Dep.(mc)
2329	18-32712	Dep.(mc)
2340	18-32137	Dep.(mc)
2357	18-31365	Dep.(mc)
2363	18-32306	Dep.(mc)
2372	18-32219	Dep.(mc)
2386	18-31546	Dep.(mc)
2398	18-31418	Dep.(mc)
2412	18-32713	Dep.(mc)
2416	18-32728	Dep.(mc)
2425	18-32307	Dep.(mc)
2430	18-31358	Dep.(mc)
2433	18-33098	Dep.(mc)
2458	18-33152	Dep.(mc)
2502	18-32884	Dep.(mc)
CERN–	**(European Organization for Nuclear Research)**	
64-30	18-31869	Dep.(mc)
64-34	18-32310	Dep.(mc)
CEX–		
64.3	18-31783	Dep.; $0.50(OTS)
CISE-R–	**(Italian)**	
82	18-31718	See EURAEC-930
CLOR–	**(Polish)**	
26	18-31753	Dep.
CONF-114–	**(The International Conference on High Energy Accelerators, Dubna, U.S.S.R., Aug. 1963)**	
28	18-32306	See CEA-R-2363
CONF-117–	**(American Chemical Society 145th National Meeting, New York, Sept. 1963)**	
45	18-31419	$2.60(fs), $0.92(mf) OTS; Gmelin, AED-CONF-63-133-58

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CONF-133	18-26873 18-26881 18-33026	(International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963)
CONF-179–		(American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964)
5	18-33164	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-033-26
CONF-182–		(9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964)
24	18-31976	ORINS. Gmelin, AED-CONF-64-008-31
29	18-31861	ORINS. Gmelin, AED-CONF-64-008-36
CONF-186	18-32378	(3rd International Conference on the Physics of Electronic and Atomic Collisions, London, July 1963)
CONF-206–		(Symposium on Carbides in Nuclear Energy, Harwell, Eng., Nov. 1963)
7	18-31430	See UCRL-7448
CONF-224	18-31581	(The Faraday Society, General Discussions, Fundamental Processes in Radiation Chemistry Conference, Notre Dame, Ind., Sept. 1963)
CONF-258–		(Sodium Components Development Program Information Meeting, Palo Alto, Calif., Aug. 1963)
4	18-33106	See NAA-SR-9718
CONF-281–		(International Conference on Beryllium Oxides, Sydney, Oct. 1963)
51	18-32105	See NAA-SR-Memo-8988
CONF-315–		(Norton Company's Symposium on the Technology of Powder Filled UO_2 Fuel Elements, Worcester, Mass., Nov. 1963)
2	18-32108	See ORNL-P-123
CONF-354	18-32326	(Accelerator Conference, Boston, Mass., Nov. 1963)
CONF-363–		(International Symposium on Plasma Phenomena, San Diego, Calif., Oct. 1963)
21	18-32946	ORINS. Gmelin, AED-CONF-63-202-21
CONF-396–		(Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Feb. 1964)
8	18-32880	ORINS. Gmelin, AED-CONF-64-019-7
9	18-32881	ORINS. Gmelin, AED-CONF-64-019-6
CONF-401–		(Institute of Electrical and Electronics Engineers 1964 International Convention, New York, Mar. 1964)
7	18-32335	ORINS. Gmelin, AED-CONF-64-015-6
CONF-402–		(American Geophysical Union 43rd Annual Meeting, Washington, D. C., Apr. 1962)
5	18-32505	ORINS
CONF-407–		(Electro Chemical Society, Toronto, May 1964)
2	18-32123	ORINS. Gmelin, AED-CONF-64-060-3
CONF-409–		(American Chemical Society 138th Meeting, New York, Sept. 1960)
3	18-31420	See GAT-T-808
CONF-416–		(American Physical Society Division of Fluid Dynamics, Cambridge, Mass., Nov. 1963)
4	18-31875	See CERN-64-30(p.65-79)
CONF-445–		(Aeronautical Systems Division 1963 Science and Engineering Symposium, Wright-Patterson AFB, Ohio, Sept. 1963)
2	18-31836	See ASD-TDR-63-697
CONF-446–		(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)
7	18-32714	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8	18-32966	See HW-SA-3355
9	18-32979	See HW-SA-3361
CONF-452–		(American Physical Society, Washington, D. C., Apr. 1964)
4	18-32877	ORINS. Gmelin, AED-CONF-64-044-1 Phys. Rev., 135: B920-33(1964)
9	18-32878	ORINS. Gmelin, AED-CONF-64-044-4
30	18-32257	ORINS. Gmelin, AED-CONF-64-044-42
CONF-471–		(American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963)
23	18-32305	ORINS. Gmelin, AED-CONF-63-268-25
26	18-32944	ORINS. Gmelin, AED-CONF-63-268-22
28	18-32304	ORINS. Gmelin, AED-CONF-63-268-26
CONF-481–		(American Physical Society Annual Meeting, New York, Jan. 1964)
66	18-32630	ORINS. Gmelin, AED-CONF-64-003-88
70	18-32729	Dep.(mc); $2.60(fs), $0.83(mf) OTS
CONF-495–		(Golden Gate Metals Conference, San Francisco, Feb. 1964)
2	18-32085	See LADC-6026
CONF-497–		(3rd United Nations International Conference on Peaceful Uses of Atomic Energy) See A/CONF.28/P-
CONF-500–		(Conference on Radiation Protection and Recovery, Oak Ridge, Tenn., Nov. 1963)
4	18-31313	ORINS. Gmelin, AED-CONF-63-263-4
CONF-502–		(International Congress of Nuclear Physics, Paris, July 1964)
15	18-32749	See UCRL-11378
16	18-32748	See UCRL-11373
CONF-504–		(American Power Conference 26th Annual Meeting, Chicago, Apr. 1964)
7	18-32209	ORINS. Gmelin, AED-CONF-64-038-7
8	18-33115	ORINS. Gmelin, AED-CONF-64-038-2
9	18-33116	ORINS. Gmelin, AED-CONF-64-038-3
CONF-506–		(Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964)
2	18-32046	See IS-872
CONF-512–		(American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964)
7	18-32222	See HW-SA-3477
8	18-32226	See ORNL-TM-880
CONF-523–		(IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963)
3	18-33140	See AEET/ROD/11
CONF-524–		(American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964)
13	18-32208	ORINS. Gmelin, AED-CONF-64-006-20
CONF-531–		(American Physical Society 1964 Southwestern Meeting, Tucson, Ariz., Feb. 1964)
6	18-32945	ORINS. Gmelin, AED-CONF-64-010-13
7	18-32879	ORINS. Gmelin, AED-CONF-64-010-14
CONF-533–		(3rd Conference on Exploding Wires, Boston, Mar. 1964)
2	18-32269	See LADC-6288
CONF-534–		(Biophysical Society 8th Annual Meeting, Chicago, Feb. 1964)
2	18-31258	ORINS. Gmelin, AED-CONF-64-016-1
CONF-537–		(USAEC-EURATOM Conference on Two Phase Flow

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		Problems, Washington, D. C., Apr.-May 1964)
2	18-31724	See ORNL-P-35
CONF-542–		(5th Symposium of the Engineering Aspects of Magnetohydrodynamics, Cambridge, Mass., Apr. 1964)
3	18-32518	ORINS. Gmelin, AED-CONF-64-036-4
4	18-31693	See MATT-264
CONF-543–		(American Physical Society 1964 March Meeting, Philadelphia, Mar. 1964)
2	18-32264	See BNL-7452
4	18-31641	ORINS. Gmelin, AED-CONF-64-028-6
CONF-549–		(International Symposium on Oxidases and Related Oxidation-Reduction Systems, Amherst, Mass., July 1964)
1	18-33185	See NYO-901-9
CONF-551–		(Technical Meeting on the Use of Induced Mutations in Plant Breeding Programs, Rome, May-June 1964)
1	18-31127	See EUR-1809.f
CONF-552–		(53rd National Meeting of the American Institute of Chemical Engineers, Pittsburgh, May 1964)
1	18-31426	See LADC-6274
CONF-553–		(American Ceramic Society 66th Annual Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964)
3	18-32207	ORINS. Gmelin, AED-CONF-64-048-11
5	18-32206	ORINS. Gmelin, AED-CONF-64-048-10
CONF-555–		(International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964)
2	18-31786	See LADC-4467
3	18-31800	See UCRL-7903
4	18-31791	See ORNL-P-4
CONF-556–		(12th Annual Meeting of the Radiation Research Society, Miami, Fla., May 1964)
1	18-33177	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-560–		(Conference on Film-Less Spark Chamber Techniques and Associated Computer Use, Geneva, Mar. 1964)
4	18-31918	See UCRL-11209(Rev.)
CONF-568–		(Conference on Industrial Applications of New Technology, Atlanta, Apr. 1964)
1	18-31987	Dep.(mc); $1.10(fs), $0.80(mf) OTS
CONF-570–		(AEC Symposium on Advanced Converter Reactor Prototypes, Washington, D. C., Mar. 1964)
1	18-32055	See ORNL-TM-859
CONF-574–		(5th Conference on Applied Meteorology, American Meteorological Society, Atlantic City, Mar. 1964)
1	18-31834	ORINS. Gmelin, AED-CONF-64-037-1
CONF-575–		(Proceedings of Colloque Weyl, Lille, June 1963)
1	18-31429	See UCRL-7265-T
CONF-576–		(Paper and Textile Supported Art Objects Symposium, New York, Nov. 1961)
1	18-31986	See BNL-7397
CONF-577–		(American Industrial Hygiene Association Annual Meeting of the Rocky Mountain Section, Albuquerque, N. Mex., Oct. 1963)
1	18-31795	See RFP-336
CONF-578–		(Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962)
1	18-31839	See INSJ-63
CONF-582–		(Share XXII Meeting, San Francisco, Mar. 1964)
1	18-33176	See BNL-7915
CONF-583–		(Conference on High Magnetic Fields, Their Production, and Their Applications, Oxford, July 1963)
1	18-32271	See MATT-208
CONF-586–		(Albuquerque Operations Office and Contractors Health Protection Conference, Kansas City, Mo., May 1964)
1	18-31796	See SC-DC-64-879
CONF-587–		(American Nuclear Society 1961 Annual Meeting, Pittsburgh, June 1961)
1	18-33022	See WAPD-T-1322
CONF-588–		(Society for Nuclear Medicine, 2nd Annual Meeting, Portland, Oreg., June 1955)
1	18-33175	See BNL-7772
CONF-589–		(American Nuclear Society Meeting, Columbus, Ohio, Sept. 1962)
1	18-32220	Dep.(mc); $2.60(fs), $1.10(mf) OTS
CONF-590–		(Symposium on Genetics, Bar Harbor, Me., June-July 1964)
1	18-31128	See LADC-6472
CONF-591–		(American Institute of Electrical Engineers Summer General Meeting, Denver, Colo., June 1962)
1	18-33188	See SC-R-64-123
CONF-592–		(9th Symposium on Ballistics Missile and Space Technology, San Diego, Calif., Aug. 1964)
1	18-31687	See LADC-6458
CONF-593–		(Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964)
1	18-32019	See LADC-6476
CONF-595–		(American Institute of Chemical Engineers (NENY), Symposium in Miniature, Latham, N. Y., Mar. 1964)
1	18-31717	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-596–		(Conference on the Progress in the Theory of Nuclear Reactors, Karlsruhe, Ger., Apr. 1963)
1	18-33019	See EUR-593.e
CONF-598–		(Meeting on Measurements and Calculation of the Influence of the Burn-up on the Reactivity, Riso, Denmark, Sept. 1961)
1	18-33020	See EUR-1620.e
CONF-599–		(3rd International Congress of Polarography, Southampton, England, July 1964)
1	18-31427	See ORNL-P-14
CONF-600–		(American Institute of Aeronautics and Astronautics, 1st Annual Meeting, Washington, D. C., June-July 1964)
4	18-33136	ORINS
6	18-32258	ORINS
10	18-33132	ORINS
11	18-32519	ORINS
13	18-33133	ORINS
14	18-33134	ORINS
15	18-32520	ORINS
18	18-32943	ORINS
25	18-33135	ORINS
37	18-32521	ORINS
40	18-32955	ORINS
41	18-31995	ORINS
42	18-32522	ORINS
CONF-602–		(Symposium on Single- and Multi-Component Flow Processes, New Brunswick, N. J., May 1964)
1	18-31720	See ILL-13-P
CONF-603–		(Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June-July 1964)
1	18-32050	See NLCO-913
2	18-32106	See NLCO-912

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CONF-604–	**(3rd Symposium on Engineering Problems in Thermonuclear Research, Garching near Munchen, Ger., June 1964)**	
1	18-32902	See UCRL-7815
CONF-605–	**(10th International Symposium in Combustion, Cambridge, Eng., Aug. 1964)**	
1	18-31360	See UCRL-7797
CONF-606–	**(American Chemical Society, Northwest Regional Meeting, Spokane, Wash., June 1964)**	
1	18-31369	See HW-SA-3461
2	18-31422	See HW-SA-3505
3	18-31657	See HW-SA-3549
CONF-607–	**(AEC Metallography Group 18th Meeting, Canoga Park, Calif., June 1964)**	
1	18-32045	See HW-SA-3579
2	18-32051	See NLCO-915
3	18-32048	See NLCO-909
4	18-32054	See ORNL-P-84
5	18-32049	See NLCO-911
CONF-608–	**(International Conference on Nuclear Magnetic Resonance and Relaxation in Solids, 13th Colloque Ampere, Leuven, Belgium, Sept. 1964)**	
1	18-32267	See COO-1198-175
CONF-611–	**(4th International Photobiology Congress, Oxford, July 1964)**	
1	18-31130	See ORNL-P-85
CONF-612–	**(IAEA Panel on Use of Nuclear Energy in Saline Water Conversion, Vienna, Austria, April 1964)**	
1	18-32968	See ORNL-P-20
CONF-614–	**(Symposium on Crystal Diffraction of Nuclear Gamma Rays, Athens, June 1964)**	
1	18-32268	See IS-927
CONF-615–	**(International Conference on Lattice Defects in Quenched Metals, Argonne, Ill., June 1964)**	
1	18-33180	See COO-1198-178
2	18-33179	See COO-1198-176
3	18-33178	See COO-1198-172
CONF-616–	**(Reactor Core Conference, Chalk River, Ontario, Canada, Jan. 1956)**	
1	18-33018	See CRRP-627
CONF-617–	**(Special Technical Conference on Nuclear Radiation Effects, Seattle, Wash., July 1964)**	
1	18-33190	See SC-R-64-181
2	18-32228	See SC-R-64-182
3	18-32229	See SC-R-64-191
4	18-32230	See SC-R-64-192
5	18-32231	See SC-R-64-193
6	18-32232	See SC-R-64-194
7	18-32233	See SC-R-64-195
8	18-32234	See SC-R-64-196
9	18-31914	See SC-R-64-197
COO–		
30-93	18-32619	Phys. Rev. Letters, 13: 141-3(1964)
770-12	18-31653	Dep.(mc); $6.60(fs), $2.03(mf) OTS
1198-172	18-33178	Dep.(mc); $2.60(fs), $0.95(mf) OTS
1198-175	18-32267	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1198-176	18-33179	Dep.(mc); $2.60(fs), $0.86(mf) OTS
1198-178	18-33180	Dep.(mc); $2.60(fs), $1.04(mf) OTS
1328-8	18-32361	Dep.(mc); $2.60(fs), $0.89(mf) OTS
CRDC–	**(Canadian)**	
1193	18-31366	Dep.; $0.50(AECL)
CRRP–	**(Canadian)**	
627	18-33018	Dep.; $0.50(AECL)
872(App.7)	18-33099	Dep.; (AECL)

Report No.	Abstract No.	Availability
CVNA–	**(Misc.)**	
99	18-33100	Dep.(mc); $5.60(fs), $1.82(mf) OTS
D–	**(Misc.)**	
709582	18-32514	See NP-14068
1-82-0332	18-32885	
1-82-0339	18-32886	
1-82-0347	18-32887	
DC–	**(Misc.)**	
60-1-60	18-33059	Dep.(mc); $9.60(fs), $3.59(mf) OTS
60-2-285	18-32038	Dep.(mc); $4.60(fs), $1.49(mf) OTS
DLCS–		
3570110	18-33101	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DP–		
868	18-32506	Dep.; $0.75(OTS)
DPST–		
64-83-5	18-33060	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DRI–	**(Misc.)**	
2166	18-32138	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC(OR)–	**(European-American Nuclear Data Committee)**	
31(L)	18-32730	Dep.(mc)
EANDC(UK)–	**(European-American Nuclear Data Committee)**	
36(U)	18-32726	See AERE-R-4649
EANDC-US–	**(European-American Nuclear Data Committee)**	
57"U"	18-32751	WASH-1048
EGCR–		
3		$0.50(OTS)
EGG–		
1183-1019		Dep., $3.60(fs), $1.13(mf) OTS
ERI–		
6		(AECL)
ETR–		
159	18-31860	See NP-14005
160	18-31861	See NP-14006
162	18-31873	See NP-14007
164	18-31874	See NP-14008
EUR–	**(European Atomic Energy Community)**	
510.d	18-31079	Z. Naturforsch., 18b: 219-24(1963)
534.d(Pt.I)	18-32948	
534.d(Pt.II)	18-32949	
552.f	18-31094	Ann. Physiol. Vegetale l'Univ. Bruxelles, 8: 47-60(1963)
586.d	18-33126	Dep.(mc)
593.e	18-33019	Dep.(mc)
1604.f	18-31359	Dep.(mc)
1610.f	18-31126	Dep.(mc)
1612.f	18-31082	Dep.(mc)
1620.e	18-33020	Dep.(mc)
1635.f	18-31547	Dep.(mc)
1644.e	18-32888	Dep.(mc)
1646.f	18-31564	Dep.(mc)
1680.f	18-31101	Compt. Rend. Soc. Biol., 157: 1416-19 (1963)
1809.f	18-31127	Dep.(mc)
EURAEC–		
930	18-31718	Dep.(mc); $10.10(fs), $3.83(mf) OTS
957	18-32035	See BMI-X-10073
974	18-32039	Dep.(mc); $2.60(fs), $0.95(mf) OTS
1018	18-32115	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1044	18-32965	See GEAP-4603

Report No.	Abstract No.	Availability
1059	18-33110	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1060	18-32063	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1064	18-32064	Dep.(mc); $2.60(fs), $0.92(mf) OTS
1066	18-32065	Dep.(mc); $2.60(fs), $0.83(mf) OTS
1068	18-32235	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1077	18-33061	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1096	[illegible]-31719	See GEAP-4592
1132	18-32136	See BMI-X-10093
1136	18-32037	See BMI-X-10092
1139	18-32036	See BMI-X-10091
FMRC–	**(Non-AEC)**	
15328	18-31740	OTS
FTD-TT–	**(Non-AEC)**	
64-528	18-32516	OTS
GA–	**(Misc.)**	
4557	18-32221	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5128	18-32978	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GAT–		
432	18-31692	Dep.; $0.50(OTS)
GAT-T–		
808	18-31420	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
4291	18-32964	Dep.(mc); $6.60(fs), $2.15(mf) OTS
4313	18-32084	Dep.(mc); $3.60(fs), $1.40(mf) OTS
4557	18-32101	Dep.(mc); $5.60(fs), $1.76(mf) OTS
4567	18-33103	Dep.(mc); $9.10(fs), $3.38(mf) OTS
4592	18-31719	Dep.(mc); $7.60(fs), $2.51(mf) OTS
4603	18-32965	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GEMP–	**(Misc.)**	
295	18-33127	Dep.(mc); $5.60(fs), $2.00(mf) OTS
GIC–		
2605-2	18-32510	Dep.; $2.50(OTS)
3362-1	18-32511	Dep.(mc); $8.10(fs), $2.87(mf) OTS
GLR–		
25	18-31725	See SAN-409-5
HASL–		
146	18-31784	Dep.; $3.50(OTS)
147	18-31083	Dep.; $1.50(OTS)
HMI-B–	**(German)**	
32	18-32016	Dep.(mc)
34	18-33182	Dep.(mc)
HW–		
55735	18-31654	Dep.(mc); $1.10(fs), $0.80(mf) OTS
62455	18-32260	Dep.; $0.50(OTS)
68600-39	18-32040	Dep.; $0.50(OTS)
73130	18-33104	Dep.; $3.00(OTS)
79194(Rev.1)	18-31367	Dep.; $0.50(OTS)
79762(P[illegible].1)	18-31655	Dep.; $1.50(OTS)
79844	18-31736	Dep.; $5.60(fs), $1.73(mf) OTS
80271	18-31837	Dep.; $2.60(fs), $1.04(mf) OTS
80566	18-32102	Dep.; $2.00(OTS)
81269	18-32041	Dep.; $2.75(OTS)
81367	18-32017	Dep.; $0.50(OTS)
81481	18-33166	Dep.(mc); $5.60(fs), $1.97(mf) OTS
81871	18-31906	Dep.; $0.50(OTS)
81955	18-31838	Dep.; $1.00(OTS)
82487	18-31368	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
3139	18-31656	Dep.(mc); $3.60(fs), $1.28(mf) OTS Ind. Eng. Chem., Fundamentals, 3: 189-95(1964)
3148	18-31421	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3355	18-32966	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3361	18-32979	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3421	18-33160	See A/CONF.28/P/287
3438	18-31818	Northwest Med., 243-4(1964)
3461	18-31369	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3477	18-32222	Dep.(mc); $2.60(fs), $0.86(mf) OTS
3505	18-31422	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3539	18-31785	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3543	18-32103	Dep.(mc); $5.60(fs), $1.79(mf) OTS
3549	18-31657	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3579	18-32045	Dep.(mc); $4.60(fs), $1.70(mf) OTS
I–	**(Misc.)**	
A2049-21	18-31696	See TID-20846
IA–	**(Non-AEC)**	
884	18-31548	Dep.(mc)
909	18-32567	Nuovo Cimento (10), 33: 752-62(1964)
IBM–	**(Non-AEC)**	
3	18-32078	Kiev, Publishing House of the Academy of Sciences, 1963
5	18-32079	Moscow, State Scientific and Technical Printing House, Literature on Ferous and Nonferous Metallurgy, 1963
IDO–		
14635	18-31658	Dep.; $1.00(OTS)
16918	18-33141	Dep.; $1.00(OTS)
16974	18-33142	Dep.; $1.25(OTS)
24457	18-33143	Dep.(mc); $1.60(fs), $0.80(mf) OTS
24462	18-33144	Dep.(mc); $5.60(fs), $1.97(mf) OTS
24463	18-33145	Dep.(mc); $10.50(fs), $4.13(mf) OTS
24465	18-33146	Dep.(mc); $5.60(fs), $2.00(mf) OTS
24466	18-33147	Dep.(mc); $17.50(fs), $8.57(mf) OTS
28626	18-33105	Dep.; $2.25(OTS)
IFA-FN–	**(Rumanian)**	
23	18-33148	Dep.(mc)
IFA-FT–	**(Rumanian)**	
51	18-32223	Dep.(mc)
IFA-HE–	**(Rumanian)**	
53	18-32528	Dep.(mc)
IITRI–	**(Misc.)**	
8262-6	18-32980	Dep.(mc); $2.60(fs), $1.10(mf) OTS
ILL–	**(Non-AEC)**	
13-P	18-31720	
INS-R–	**(New Zealand)**	
27	18-31370	Dep.(mc)
INSJ–	**(Japanese)**	
63	18-31839	Dep.(mc)
IS–		
693	18-32189	J. Less-Common Metals, 6: 439-50(1964)
736	18-32163	Acta Met., 12: 744-5(1964)
756	18-32167	Am. Soc. Metals, Trans. Quart., 57: 337-45(1964)
790	18-31513	Spectrochim. Acta, 20: 1117-27(1964)
793	18-31555	J. Am. Chem. Soc., 86: 2278-82(1964)
796	18-31379	Anal. Chim. Acta, 31: 11-16(1964)
799	18-32047	Dep.; $0.75(OTS)
829	18-31497	J. Phys. Chem., 68: 2028-9(1964)
830	18-31721	Dep.; $2.50(OTS)
851	18-32018	Dep.; $0.75(OTS)
872	18-32046	Dep.(mc); $9.10(fs), $3.50(mf) OTS
927	18-32268	Dep.(mc); $1.60(fs), $0.80(mf) OTS
IS-Trans–		
3	18-31439	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
ISS–	**(Italian)**	
64/5	18-32731	Dep.(mc)
64/8	18-32732	Dep.(mc)
64/10	18-32733	Dep.(mc)
64/11	18-31907	Dep.(mc)

Report No.	Abstract No.	Availability
64/12	18-32529	Dep.(mc)
JEN-	**(Spanish)**	
121-DQ/I-36	18-31659	Dep.(mc)
123-DQ/I-37	18-31549	Dep.(mc)
126	18-31423	Dep.(mc)
JINR-	**(Russian)**	
P-1634	18-32530	Dep.(mc)
JPRS-	**(Non-AEC)**	
25068	18-31801	$2.00(OTS)
25069	18-32066	$1.50(OTS)
25214	18-31802	$1.50(OTS)
25233	18-31132	$0.50(OTS)
25250	18-31803	$0.50(OTS)
25251	18-31262	$0.50(OTS)
25274	18-31133	$0.50(OTS)
25289	18-32691	$0.75(OTS)
25350	18-31261	$0.75(OTS)
JüL-	**(German)**	
144-PC	18-32512	Dep.(mc)
KAPL-		
3019	18-32140	Dep.(mc); $5.60(fs), $1.82(mf) OTS
KFK-	**(German)**	
68	18-31804	For translation see NP-tr-1153
158	18-32104	Dep.(mc)
187	18-31840	Dep.(mc)
195	18-31236	Strahlentherapie, 122: 437-48(1963)
197	18-31424	Dep.(mc); $2.00(Gmelin, AED-DISS-63-478)
222	18-31639	p.43-55 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, IAEA, 1964
KFKI-	**(Hungarian)**	
14/1963	18-32734	Dep.(mc)
64-3	18-32715	Dep.(mc)
KY-		
429	18-31371	Dep.; $0.50(OTS)
LA-		
3078	18-32889	Dep.; $0.75(OTS)
LA-tr-		
64-7	18-31440	Dep.(mc); $2.60(fs), $0.86(mf) JCL
LADC-		
4467	18-31786	Dep.(mc); $3.60(fs), $1.22(mf) OTS
4898	18-32203	p.222-58 of "Progress in the Science and Technology of the Rare Earths. Vol. 1." Oxford, Pergamon Press, 1964
5823	18-31908	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5868	18-32142	Dep.(mc); $2.60(fs), $0.83(mf) OTS
5869	18-32141	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5902	18-33183	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5905	18-31425	Dep.(mc); $2.60(fs), $1.10(mf) OTS
5909	18-33184	$2.60(fs), $1.10(mf) OTS
5919	18-32362	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5940	18-33167	Dep.(mc); $4.60(fs), $1.70(mf) OTS
5946	18-32143	$1.60(fs), $0.80(mf) OTS
6026	18-32085	Dep.(mc); $3.60(fs), $1.19(mf) OTS
6147	18-32023	Am. Math. Monthly, 71: 516-20(1964)
6187	18-32342	Nature, 201: 1202(1964)
6260	18-32921	J. Appl. Phys., 35: 2351-63(1964)
6274	18-31426	Dep.(mc); $2.60(fs), $1.04(mf) OTS
6288	18-32269	Dep.(mc); $2.60(fs), $1.04(mf) OTS
6305	18-32369	J. Chem. Phys., 41: 1164-5(1964)
6448	18-31506	Phys. Rev. Letters, 13: 13-15(1964)
6458	18-31687	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6472	18-31128	Dep.(mc); $2.60(fs), $0.86(mf) OTS
6476	18-32019	Dep.(mc); $1.10(fs), $0.80(mf) OTS
LAL-	**(French)**	
1081	18-32306	See CEA-R-2363
1108	18-32735	Dep.(mc)
1111	18-32531	Dep.(mc)
LAMS-		
3086	18-32890	Dep.; $0.50(OTS)
LFEN-	**(Portuguese)**	
N1.12	18-33021	Dep.(mc)
LNF-	**(Italian)**	
64/1	18-32311	Dep.(mc)
64/2	18-32270	Dep.(mc)
64/5	18-32312	Dep.(mc)
64/15	18-32532	Dep.(mc) Nuovo Cimento (10), 33: 657-62(1964)
64/18	18-31909	Dep.(mc)
64/19	18-32313	Dep.(mc)
64/25	18-32314	Dep.(mc)
MATT-		
208	18-32271	Dep.(mc); $1.60(fs), $0.80(mf) OTS
264	18-31693	Dep.(mc); $3.60(fs), $1.19(mf) OTS
MIT-	**(Misc.)**	
2073-1	18-33062	Dep.(mc); $12.00(fs), $5.12(mf) OTS
2079-1	18-31841	Dep.(mc); $2.60(fs), $1.01(mf) OTS
MITNE-	**(Misc.)**	
51	18-33062	See MIT-2073-1
MLM-		
1186	18-32020	Dep.; $0.50(OTS)
MND-	**(Misc.)**	
3149-1	18-32513	
MP-	**(Non-AEC)**	
6-643	18-31689	See NP-14063
MSAR-	**(Misc.)**	
64-75	18-32144	Dep.(mc); $1.60(fs), $0.80(mf) OTS
MTI-	**(Misc.)**	
64TR-25	18-31722	OTS
N-	**(Misc.)**	
64-15987	18-32734	See KFKI-14/1963
NAA-SR-		
9525(Vol.I)	18-33128	Dep.; $3.00(OTS)
9718	18-33106	Dep.; $0.75(OTS)
NAA-SR-Memo-		
8988	18-32105	Dep.(mc); $5.60(fs), $1.88(mf) OTS
9776	18-32967	Dep.(mc); $2.60(fs), $0.95(mf) OTS
NASA-CR-	**(Non-AEC)**	
54066	18-32086	
NBS-	**(Misc.)**	
5471	18-31910	Dep.(mc); $5.60(fs), $1.73(mf) OTS
NDL-SP-	**(Non-AEC)**	
7	18-31372	
NDL-TR-	**(Non-AEC)**	
58(Pt.I)	18-31754	
58(Pt.II)	18-31755	
63	18-31787	
NIRL-R-	**(British)**	
55	18-32315	Dep.(mc)
64	18-32316	Dep.(mc); $0.70(BIS); 3s. 6d. (HMSO)
66	18-32317	Dep.; $0.80(BIS); 4s. (HMSO)
NLCO-		
901	18-31694	Dep.; $1.00(OTS)
909	18-32048	Dep.(mc); $1.10(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
911	18-32049	Dep.(mc); $1.10(fs), $0.80(mf) OTS
912	18-32106	Dep.(mc); $2.60(fs), $0.83(mf) OTS
913	18-32050	Dep.(mc); $1.60(fs), $0.80(mf) OTS
915	18-32051	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NMI-	(Misc.)	
2813	18-32145	Dep.(mc); $4.60(fs), $1.52(mf) OTS
NP-	(AEC File No. for Non-AEC Reports)	
13936	18-32533	Dep.(mc)
13975	18-31060	Dep.(mc)
13989	18-32534	Dep.(mc)
13998	18-31911	Dep.(mc)
14005	18-31660	$2.60(fs), $0.95(mf) OTS
14006	18-31661	Dep.(mc); $6.60(fs), $2.27(mf) OTS
14007	18-31373	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14008	18-31374	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14045	18-31260	
14052	18-31788	Dep.(mc)
14062	18-33129	Dep.(mc)
14063	18-31689	Dep.; $1.00(OTS)
14068	18-32514	
14071	18-32891	Dep.(mc)
14072	18-31723	Dep.(mc)
14077	18-32892	Dep.(mc)
14078	18-33063	Dep.(mc)
14081	18-32535	Dep.(mc)
14083	18-32903	Dep.(mc)
14089	18-31912	Dep.(mc)
14090	18-32536	Dep.(mc)
14092	18-32736	Dep.(mc)
14094	18-32737	Dep.(mc) At. Energ. (USSR), 17: 3-9(1964)
14098	18-31756	Dep.(mc)
14109	18-32052	
14112	18-32272	
14118	18-32273	Dep.(mc)
14120	18-32274	Dep.(mc)
14121	18-31913	Dep.(mc)
14122	18-31550	
14125	18-31061	
14128	18-32107	
14144	18-32053	
14152	18-32928	Phys. Letters, 10: 281-2(1964)
NP-tr-	(AEC File No. for Non-AEC Translations)	
1153	18-31804	Dep.(mc); $6.60(fs), $2.09(mf) JCL
1155	18-31998	
NRL-	(Misc.)	
F12	18-31756	See NP-14098
NUS-		
167	18-31789	Dep.(mc); $4.60(fs), $1.58(mf) OTS
NYO-		
901-9	18-33185	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1807-3	18-32836	See TID-19508
1957-38	18-32813	Phys. Letters, 10: 300-3(1964)
2546	18-31565	Dep.(mc); $2.60(fs), $0.86(mf) OTS
2761	18-31129	Dep.; $2.00(OTS)
2910-3	18-31843	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2910-4	18-31842	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9323	18-31790	Dep.(mc); $11.50(fs), $4.73(mf) OTS
ORA-	(Misc.)	
03106-15-T	18-32272	See NP-14112
ORNL-		
3475	18-33107	Dep.; $2.75(OTS)
3652	18-32893	Dep.; $2.75(OTS)
ORNL-P-		
4	18-31791	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14	18-31427	Dep.(mc); $4.60(fs), $1.52(mf) OTS
20	18-32968	Dep.(mc); $1.60(fs), $0.80(mf) OTS
34	18-31479	J. Chem. Phys., 41: 1153-4(1964)
35	18-31724	Dep.(mc); $1.60(fs), $0.80(mf) OTS
84	18-32054	Dep.(mc); $1.60(fs), $0.80(mf) OTS
85	18-31130	Dep.(mc); $3.60(fs), $1.25(mf) OTS
123	18-32108	Dep.(mc); $2.60(fs), $0.89(mf) OTS
ORNL-TM-		
623	18-31470	J. Chem. Eng. Data, 9: 387-8(1964)
745	18-33149	Dep.(mc); $8.10(fs), $2.87(mf) OTS
804	18-31997	Dep.(mc); $1.60(fs), $0.83(mf) OTS
859	18-32055	Dep.(mc); $2.60(fs), $0.98(mf) OTS
862	18-32224	Dep.(mc); $4.60(fs), $1.52(mf) OTS
877	18-32225	Dep.(mc); $3.60(fs), $1.13(mf) OTS
880	18-32226	Dep.(mc); $5.60(fs), $1.73(mf) OTS
892	18-31662	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL-tr-		
191	18-31999	Dep.(mc); $1.10(fs), $0.80(mf) JCL
230	18-32000	Dep.(mc); $1.10(fs), $0.80(mf) JCL
OTS-	(Misc.)	
63-11409/6	18-31062	$2.25(OTS)
63-11456/1	18-31063	$1.00(OTS)
64-31473	18-31801	See JPRS-25068
64-31474	18-32066	See JPRS-25069
64-31541	18-31802	See JPRS-25214
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3157	18-32227	
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960,448	18-31642	
961,414	18-31704	
961,576	18-31643	
961,661	18-32983	
961,764	18-32010	
961,827	18-33043	
961,832	18-32984	
961,883	18-31683	
961,925	18-31684	
961,927	18-32985	
961,940	18-31644	
962,037	18-31705	
962,189	18-33044	
962,240	18-32986	
962,266	18-32987	
962,311	18-33045	
962,383	18-32523	
962,428	18-32124	
962,568	18-32210	
962,582	18-31645	
962,625	18-33046	
962,634	18-32125	
962,655	18-31706	
962,990	18-31862	
963,057	18-31707	
963,073	18-32211	
963,145	18-32988	
963,161	18-33047	
963,162	18-33066	
963,198	18-31708	
963,208	18-31709	
963,215	18-32989	
963,352	18-31540	
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PATENTS	(French)	
1,291,633	18-32990	
1,294,154	18-32991	
1,294,196	18-33117	
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1,294,954	18-31735	
1,295,051	18-33118	
1,303,138	18-33048	
1,303,680	18-33049	
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1,304,928	18-32994	
1,306,796	18-33050	
1,307,545	18-33119	
1,307,615	18-32995	
1,317,167	18-32996	
1,317,193	18-32997	
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1,317,564	18-32999	
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1,322,444	18-33000	
1,328,572	18-33001	
1,329,117	18-33002	
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1,164,671	18-32097	
1,165,001	18-31541	
1,165,173	18-33067	
1,165,174	18-33003	
1,165,279	18-31542	
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1,167,037	18-32212	
1,167,038	18-32213	
1,167,063	18-31415	
1,167,990	18-33007	
1,168,649	18-32214	
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3,139,370	18-31714	
3,139,384	18-33008	
3,139,527	18-31981	
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3,140,410	18-32525	
3,140,411	18-32526	
3,141,782	18-32127	
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PATENTS	**(U.S.S.R.)**	
159,240	18-31863	
159,584	18-32527	
160,238	18-32336	
160,553	18-32128	
PHRO-DEV–		
128	18-31792	Dep.(mc); $1.60(fs), $0.80(mf) OTS
129	18-31793	Dep.(mc); $1.10(fs), $0.80(mf) OTS
POR–	**(Non-AEC)**	
1810	18-32276	Dep.(mc); $3.60(fs), $1.13(mf) OTS
PPAD–		
304D	18-32537	Dep.(mc); $5.60(fs), $1.94(mf) OTS
512D	18-32318	Dep.(mc); $3.60(fs), $1.40(mf) OTS
PR-P–	**(Canadian)**	
61	18-32277	Dep.; $1.50(AECL)
PWAC–	**(Misc.)**	
433	18-32738	Dep.; $0.75(OTS)

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Q–	**(Misc.)**	
A2392-3-12	18-31697	See TID-20847
R–	**(Misc.)**	
63FPD-130	18-32278	
64SD-1	18-31794	$7.60(OTS)
2271	18-32039	See EURAEC-974
5776-1	18-32053	See NP-14144
RFP–		
336	18-31795	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RISÖ–	**(Danish)**	
75	18-32901	Dep.(mc)
77	18-32146	Dep.(mc)
79	18-32279	Dep.(mc)
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4546	18-31775	Dep.; $0.50(OTS)
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132	18-31594	J. Chem. Phys., 41: 994-8(1964)
RT-BIO–	**(Italian)**	
(63)4	18-31146	Arch. Ital. Anat. Embriol., 1-44(1963)
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(64)-3	18-33108	Dep.(mc)
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409-5	18-31725	Dep.(mc); $2.60(fs), $1.10(mf) OTS
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3477	18-31483	J. Inorg. Nucl. Chem., 26: 1139-42(1964)
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64-100	18-31737	Ind. Quality Control, 20: 11p.(1964)
64-123	18-33188	Dep.(mc); $2.60(fs), $0.92(mf) OTS
64-148	18-33189	Dep.(mc); $3.60(fs), $1.13(mf) OTS
64-181	18-33190	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64-182	18-32228	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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64-194	18-32232	Dep.(mc); $2.60(fs), $0.89(mf) OTS
64-195	18-32233	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64-196	18-32234	Dep.(mc); $1.10(fs), $0.80(mf) OTS
64-197	18-31914	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SC-RR–		
64-512	18-33191	Dep.(mc); $6.60(fs), $2.30(mf) OTS
64-524A	18-33150	Dep.; $1.25(OTS)
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64-28	18-33192	Dep.(mc); $8.10(fs), $2.79(mf) OTS
64-637	18-33193	Dep.; $0.75(OTS)
SCL-TM–		

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64-1	18-31747	See UCRL-13109
SLAC-PUB–		
34	18-32847	Phys. Rev. Letters, 13: 29-32(1964)
SRIA–		
8	18-33168	Dep.(mc); $9.60(fs), $3.80(mf) OTS
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21/11	18-31681	1964. Bibliographical Series No. 11. $2.50; Sch 52.50; 15s.stg; F.fr.10; IAEA
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TE–	**(Non-AEC)**	
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7519-T(Rev.)	18-32286	J. Chem. Phys., 40: 2048-9(1964)
7648	18-32744	Dep.; $2.25(OTS)
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Volume 18

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July-September

1964

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

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